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THE FOUNDRY

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Trade Outlook.

The question with most foundrymen to-day is not to obtain new orders but to be able to lay their hands upon enough pig iron and coke to fill the contracts already booked. Several firms have been known to remark that they have turned away more work than they have accepted, and while such statements may be somewhat exaggerated, there is not the least doubt that every well-equipped shop has been able to find work in plenty, yet the prices at which castings have been sold cannot in any way be said to have kept pace with the advances made in other iron and steel products, for which the founder has no one but himself to blame. It is as yet a favorite amusement with some shops to put in low bids on jobs they could never handle should they be so unfortunate as to secure them, and all of this just to nag a competitor and make him feel that there are other people in the business. Then some of these same fellows will see pig iron almost double in price and cheerfully pay the bill, while they will resent to the last a demand from their employes for an increase of wages. Taking it all in all, it would seem as if some of the energy here expended could be utilized to better advantage in bringing about greater harmony in the prices at which castings are sold.

The month of March has brought with it the usual spring fever in the field of labor, and the uneasiness generally prevailing previous to the first of May is with us this year also. This is not said with any special reference to the foundry trade, but disturbances in other industries always affect the makers of castings. It is not believed that there will be any concerted movement on the part of the machinists for a shorter workday or a materially higher rate of wages this year. The stove founders and their molders will likely adjust their differences in conference, as they have for several years past in a way satisfactory to both parties. The compromise effected in the Cleveland district, fixing the rate for machinery molders at $2.90, removes the chief locality in which trouble was to be looked for, and both foundrymen and molders may well be satisfied that what threatened to become a serious rupture has been disposed of. While the molders are involved in a number of disputes with their employers, these are nearly all of minor importance, and the vast majority are taking place in what are popularly called "low wage districts," which have for years been a thorn in the side of foundries paying a fair rate of wages, as well as a constant source of annoyance to the molders.

In a general way iron, which can be delivered on order, commands a varying premium over purchases wherein the question of time does not enter. The car-wheel foundries have been heavy buyers of Southern charcoal, with the result that the output from that quarter is considered as placed for the year. While the large producers of southern foundry irons have right along endeavored to prevent such advances as would tend to check trade in general, there is a belief that they have practically disposed of all the iron they have made during the year, and those who are so fortunate as to control a supply will likely take some advantage of the eagerness to buy. Several small lots of foreign iron are expected, but this will not in any way affect general conditions. The following market reviews, from different sec-

tions, as given by Rogers, Brown & Co., are of interest:

Birmingham: The tone of the iron market is strong and most of the furnaces are sold ahead and practically out of the market on many grades. The present condition of the market is, however, working a hardship in some cases. Foundries who for a long time have used certain brands in their mixture now find that not only has their favorite furnace withdrawn from the market, but they are unable even at an advance in price to secure the grade of iron they require. Two years ago when No. 2 Foundry was quoted at $18.00 Birmingham, it was always possible to buy iron at a price, but at the present time it is impossible to secure some grades even at an advance over the nominal market.

Cincinnati: If the present demand continues it probably will be the furnaces having iron to sell who will determine the price. Not all foundrymen care to have iron kept down, for many of them sell castings on a sliding scale and it is not for their advantage to make settlements on a lower schedule than actual price at which deliveries of iron can be obtained before July.

New York: How far the scarcity of iron is due to temporary causes, commencing with the car famine of December and January, and how far it results from real excess of consumption over production, no man can say with certainty. It is true that deliveries of American iron this side of October are hard to secure at any price, and it is significant that the largest melters are rapidly covering for the last quarter of the year. The small price changes that are made by sellers, under these conditions, show how much better the situation is in hand than it was in 1899.

Buffalo: Whatever may be the final result, there is every appearance at present that furnaces are not interested in securing new business. So far as possible they are anxious to protect old customers with such tonnage as they need, at conservative prices. The liberal total of such sales is rapidly filling up order books until the end of 1902.

Information Wanted.

The Editor of THE FOUNDRY will be pleased to have any information possible concerning the whereabouts and occupation of Mr. C. L. Hartsfeld, about whom items have appeared in this publication at various times during the past few years. Please address this to the Editor, giving such particulars as possible.

The Sentiment of the Molders Towards a Change in the Apprentice Ratio.

The law that supply and demand regulate prices holds good to a certain extent with labor also, and for that reason those engaged in any trade cannot be particularly criticized if they do not invite an increase in competition in that field wherein they sell their labor. If a vote of the foundrymen could be polled they would certainly say that there were shops enough in existence to make all the castings the country required and that to build more would be to invite fiercer competition. It is but a few years ago that there were more foundries than could be kept in operation and more molders than could find jobs at their trade. The activity of the past two years has not only filled the older plants with work but has also given us in the neighborhood of five hundred new shops, and it is but natural to suppose that the supply of molders has increased at least at the same ratio. However that may be, several of the foundrymen's associations have insisted that the established ratio of apprentices permitted in shops working under the jurisdiction of the Iron Molders' Union, which is one apprentice to every eight journeymen and one for the shop, irrespective of the number of men employed, is not capable of producing workmen in sufficient numbers. This assertion is conceded to be true by both sides, especially so far as the stove foundries are concerned, and the effort to secure a modification of the ratio therefore becomes a matter of general interest.

The Iron Molders' Union recently submitted the following proposition to a vote of its membership: "*Resolved*, It is necessary, in order to maintain a proper supply of competent molders, that one apprentice shall be employed to every five journeymen; it being understood that one apprentice additional shall be allowed to the shop irrespective of the number of journeymen employed." The returns show that out of 16,346 votes cast only 504 were in favor of same, while 15,842 opposed it, thus defeating the proposition thirty to one. Of course this can only be taken to indicate that the rank and file of the molders believe that there are enough men engaged in the trade to render a revision of their rules unnecessary. In short their vote demonstrates a desire to protect themselves as far as possible against a possible oversupply of mechanics.

There would indeed be a great scarcity of molders today if these had only been taught the trade in strict conformity with the laws of the molders' union. In the first place the trade

not only becomes depleted through age and disability, as the occupation is not so agreeable but that a large number leave after following it for a few years. The average boy in choosing a vocation naturally picks out the one which to him holds out the least work and the most money, and we all know the foundry industry is not at the head of the class, no matter how much one may talk about the nobleness of the trade. The fact is that the average molder, earning say two dollars and a half a day, does not have to inherit any special luck in order to better himself. The only way the foundrymen can have and hold a liberal supply of trained mechanics is to pay a price which draws young men towards the trade. They certainly can never offer those who enter it any great share of easy work and the only remedy to offset hard work is high wages.

On the other hand, men and boys break into the trade through a large number of shops outside of the control of the union. It is true that a great many of these do not really require skilled help and are not competent to teach the molders' trade, yet industrious young men seeking to better themselves, graduate from these and drift around until they become fairly good mechanics and attention to business continually improves them. These specialty shops are probably responsible for the fact that the supply of molders is as large as it is. Although many foundries are experiencing a scarcity of molders it should not be overlooked that a whole lot of these belong to that class which is not affected by the rules and regulations of union shops. When concerns making bench work and light castings in general, who have enjoyed unlimited liberties in hiring whoever they pleased, complain of not being able to obtain enough sand-pounders, it is very evident that the shortage of casting-makers is not entirely due to the apprentice laws of the molders' union. The same complaint of inability to obtain sufficient help is heard not only in other trades but also from people in search of the lowest grade of labor. The ordinary foundry helper is in many localities a much sought man and even more pay does not seem to make him come forward in sufficient quantities.

Seriously we do not believe that the molders of the country have anything to fear through permitting their by-laws to be so altered as to be more in conformity with present conditions. The trade will attract newcomers only so far as it holds out greater inducements than other fields of industry.

Oil as a Fuel for Brass Furnaces.

Having just noticed in the February FOUNDRY your request for opinions in regard to the use of fuel oil for melting brass, I give you a little outline of an experiment in our brass foundry which may be of some interest to you. Owing to the very high price of coke ruling here about two years ago, I decided to install as an experiment a fuel oil furnace, but for obvious reasons I do not mention the make, though it was the best which could be bought. I carried out a long series of experiments extending over twelve months, but in the end scrapped the furnace and added another coke furnace to the thirteen already in operation. I tried several kinds of oil including the best grades of Borneo oil, Scotch Shale oil, and cheap grades of creosote oil, and in speed of melting as well as cost per 120 pounds melted (this being the size of crucible used), the Scotch Shale oil came out best, but none of them showed more than 10 per cent saving in fuel over our coke furnaces even with coke at seven dollars per ton (2,240 pounds). This was much more than counterbalanced by the fact that while one man can easily attend to the thirteen or fourteen coke furnaces, it would not have been safe to have more than four or five oil furnaces to one man, even if he could properly watch so many, as they require very careful regulation of blast and oil supplies to obtain good results as to fuel economy. We had endless trouble also with the crucibles and undoubtedly, whatever is the reason, could not get these to stand within one-third of the heats which crucibles from same delivery stood in the coke furnaces, and in fact the average was not much above one-half. For my own satisfaction and to carry the trial as far as possible, I imported crucibles from the best makers in the United States and also from Germany and tested them against our English crucibles, but with the same result, and after a few experiences of broken crucibles in the furnace stopped experimenting in that line perhaps a little wiser but certainly considerably out of pocket. I will add that in addition to plumbago crucibles as mentioned, I tried fire clay crucibles, but the oil affected these in exactly the same manner. YORKSHIREMAN.

The Wireton Heating Co., whose plant at Blue Island, Ill., recently burned, will locate their new works at Chicago Heights, Ill. A foundry 80x150 feet will furnish castings needed in the company's output.

Hardness of English and American Irons.

I have noticed the short item on this subject in the February issue of THE FOUNDRY, and as a fairly large user of both irons, melting anywhere from 12 to 20 tons per day, one-third of which was American iron, for over three years, am prepared to say that at the present day the average American iron is beyond comparison softer than the average English iron. If the gentleman who arrived at an opposite conclusion had compared American iron with Scotch irons I could understand how he might be right, as the American brands we used were a near approach to these both in analysis and results obtained. I do not mention the brand we used, for, having nothing to work on beyond shippers' advice, none of us were clever enough to decipher the marks on the ugly lumps which were called pigs. It was, however, a good iron, and the price being right, we used it, but that is over a year ago. One thing may account for the remark made and that is that in the machine tool trade, or rather in one branch of it, there has been a tendency to use American and Scotch irons more largely than before to enable work to be machined more rapidly. I am not a machine tool maker and as a user of several of the best makes of tools of both countries think that in this respect my countrymen are not exactly wise as for example it costs more to keep the bed of an American screw-cutting lathe true after three or four years' hard work than good English lathes would cost after twice that service. I could show machines put down within a few days of each other which have done exactly the same class and quantity of work and if selling them out of the shops today should expect and would get 50 per cent more for the English lathes, although when new I paid 10 per cent more for the American than the English.

YORKSHIREMAN.

The Foundry of John Lang & Sons, Johnstone, Scotland.

We write and we talk a great deal about modern foundries in America, forgetting at the same time that the greatest number of plants engaged in this trade are anything but modern. We are also liable to overlook the fact that other countries have nice shops, well equipped in every way, just like we have. As an example of this we show this month some illustrations from the foundry of John Lang & Sons, at Johnstone, Scotland. This company for many years purchased their castings, used in the manufacture of machine tools, from local foundries, but the uncertainty of deliveries as well as the quality of the castings recently induced them to erect a foundry for their own use.

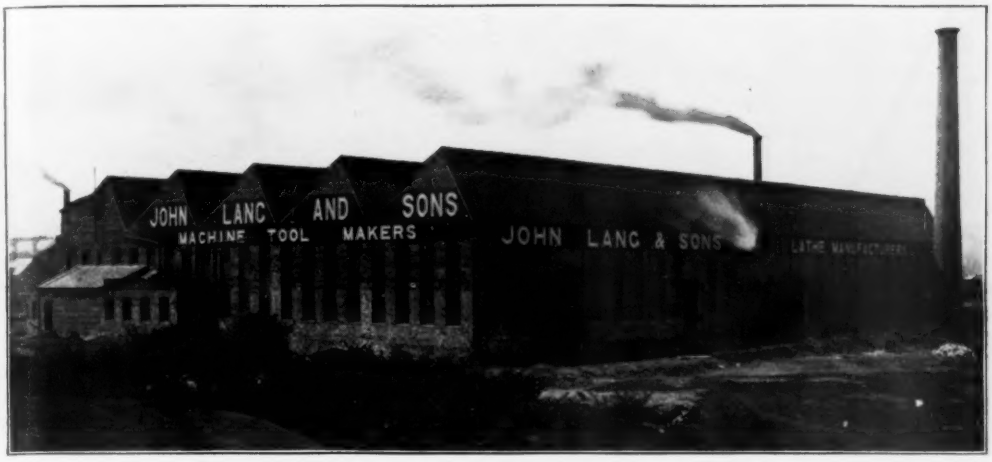
This is located on the Greenock branch of the Glasgow & Southwestern Ry., and commands excellent shipping facilities. It is connected to the machine shop by means of the industrial railway shown on plan, so that castings can readily be transferred. All the intervening ground belonging to the firm, so there is plenty of room for future extensions.

The main building is 253 ft. by 158 ft. The offices, engine-house, boiler-house, cupolas, and core-ovens are under one roof. On the south-east side, under a separate roof, are the lavatory, and workmen's lockers, which will be referred to later on.

The height of the main building from floor level to eaves is 26 ft., and to the apex of the ridges is 43½ ft. It is erected on the steel skeleton principle, having 78 steel pillars supporting the roof on three sides independently of the walls. The pillars are steel column joists of H section, 16 in. by 6 in., weighing 68 lbs. per foot, embedded in concrete blocks 4 ft. 6 in. by 4 ft. 6 in. by 3 ft. deep, dividing the shop into five bays each of 30 ft. clear span. Running longitudinally along the tops of the steel columns are 12 in. by 6 in. steel H beams, 54 lbs. per foot, supporting the roof.

Provision for light and ventilation is a particular feature of the whole works. The roof being built on the saw-tooth principle, there is a glass skylight in each bay 253 ft. long by 14 ft. wide, thus giving a total area of roof lights of 17,710 sq. ft., while the side windows have a total area of 5,290 sq. ft., giving a grand total of 23,000 sq. ft. of lighting surface, making the interior of the foundry almost as light by daylight as it is outside, a result, we think, which is not surpassed anywhere. The glass in the roof lights is of a special construction, being of ¼ rough cast plate glass, having a wire mesh cast in, thus increasing its strength and enabling it to stand the roughest usage.

Ventilation is provided by means of louvres of a peculiar construction, allowing the free egress of vitiated air, dust, smoke and gases, while preventing rain or snow from drifting in. These ventilators are each 3 ft. deep, and are placed at the apex of each of the bays, and run the whole length of the building. Special precautions are taken to minimize the amount of smoke, dust, and gas inside the foundry, and any arising from the casting or molds passes rapidly away through the ventilators.



FOUNDRY OF JOHN LANG & SONS, JOHNSTONE, SCOTLAND.

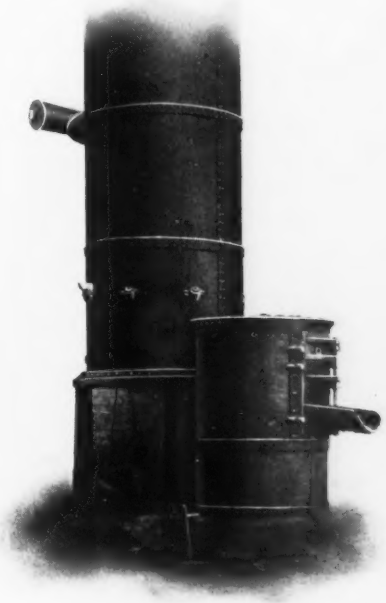
Four of the bays are suitable for the erection of overhead traveling cranes, the other being occupied by the engine-room, cupolas, etc. In addition to the traveling cranes, provision has been made for installing a number of small swing cranes; these are bolted to the steel pillars, and have a radius of about 10 ft., so that one crane swings within the radius of the other. The firm are considering the advisability of attaching pneumatic hoists to these cranes, with a complete installation of air compressors, pipes, and fittings.

For transferring the castings to the cleaning department, there is an equipment of Hudson's portable rails with trucks to suit. The rails are in sections of 15 ft. long, connected by steel cross ties; the gage is 24 in. The weight of each section being only 90 lbs., they can easily be taken up and laid down wherever they may be required about the foundry. Of course, in a foundry of this class, it is impossible to lay down a permanent railway on the molding floor; but this difficulty was of easy solution.

The trucks have a channel iron frame and steel wheels. The dimensions are 5 ft. 6 in. long by 2 ft. 6 in. broad by 1 ft. 5½ in. high, the diameter of wheels being 15 in. They are each constructed to carry a weight of three tons.

The portable railway is connected to the permanent railway system running in the yard along the whole front of the foundry, through the shop, and making connection at the other end with the industrial railway to the machine shop. It is of great convenience in carrying all the supplies requisite for the foundry from the railway trucks which are discharged in the yard, as well as in transferring small ladles or other material throughout the foundry.

Storage for raw material is provided in sheds of large capacity, erected in the yard. Into these the railway cars discharge sand, coal, coke, limestone, pig iron, etc. An Eberhardt sand mixer is provided, close to which is a German-made core machine, which turns out cores of any shape corresponding to the die let into the surface of the table. The length of the cores can be varied by means of an adjustable stop on the hand wheel and when once set the machine is ready to turn out



LITTLETON CUPOLA.

an indefinite quantity of cores exactly similar in length and shape.

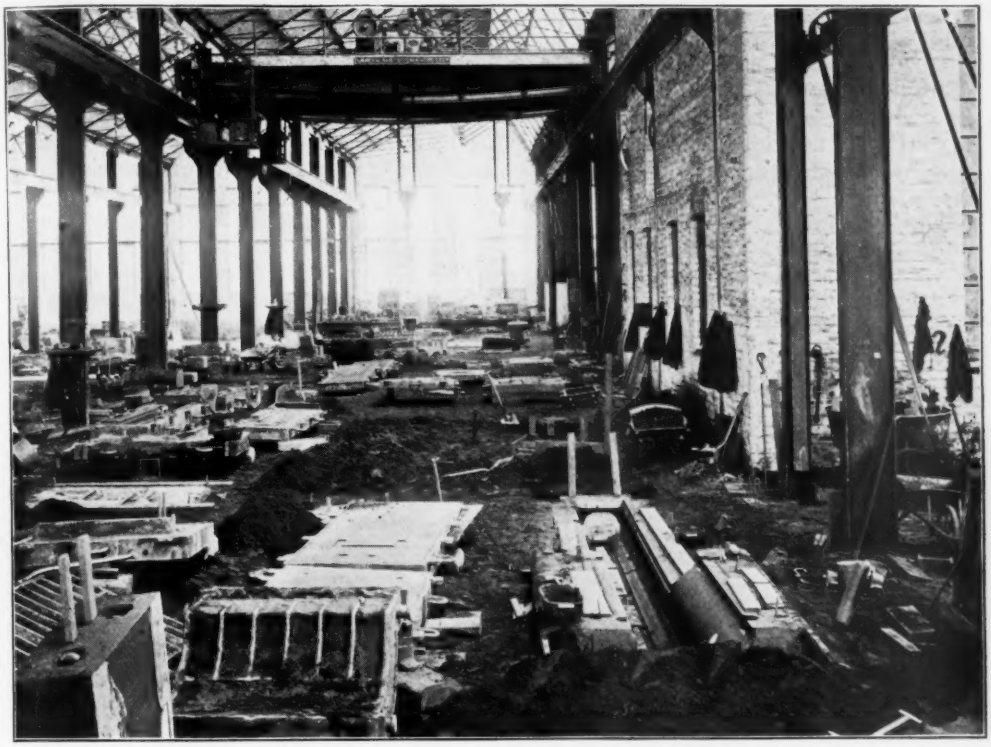
In the cleaning room of the foundry are the rumblers for small castings. These are of the Stover type, having exhaust pipes leading all dust outside of the building. For making and repairing the tools and flasks, a smith's fire, fitters' benches, and several drilling machines are provided.

The floor of the foundry has an average depth of 4½ ft. of sand. There is no pit, as the castings to be made are not of a size to demand this, though provision has been made to take care of a heavier class of work, if necessary. Many of the castings required are consumed in large quantities and for such molding machines both English and American are used.

Another innovation which this firm has introduced into its foundry is snap flasks of the variety common in this country. British foundries are beginning to recognize the value of these for turning out small castings and are conceding that a greater output can be obtained therefrom for this class of work than from the heavy iron flask. The greater part of the work is, of course, too heavy for snap work and here iron boxes are employed. These are perfectly interchangeable, a step in the right direction.

At the side of the engine-room is erected the cupola and receiver. This is one of Littleton's patent cupolas, supplied by the Sturtevant Engineering Co., who also supplied the blower. The cupola has a melting capacity of five tons per hour under ordinary working conditions. It is 60½ in. outside diameter and 42 in. inside diameter. The height from floor level to charging door is 20 ft. The upper portion of the cupola is lined with hollow cast-iron bricks, and the blast is introduced at a high level into the annular space formed by them. Two or more courses of these bricks communicate with each other by means of an opening in the adjoining bricks, and the blast, after passing round the cupola two or more times, is taken to the tuyeres. The hearth is contracted so that a small bed charge only is required. By

PLAN OF FOUNDRY. JOHN LANG & SONS, JOHNSTONE, SCOTLAND.



VIEW OF BAY NEXT TO CUPOLA. JOHN LANG & SONS' FOUNDRY.

this method it is claimed that the cupola produces hot fluid iron rapidly with a minimum amount of fuel, and requires only a moderate pressure of blast for the purpose, thereby reducing the power absorbed in driving the fan. The cast-iron bricks stand the wear and tear incidental to charging much better than the fire bricks usually employed, so that the continual expense of re-lining the cupola is very much reduced. The cupola is fitted with a drop bottom, and is connected at the front to a receiver standing 5 ft. 7½ in. high, the out-

CHIPPING ROOM. JOHN LANG & SONS' FOUNDRY.

side diameter of which is 3 ft. 6 in., having a capacity of about 45 cwts. of melted metal.

The charging platform of the cupolas has a floor of iron plates, and is entirely under cover, its roof being part of the main roof of the foundry. The floor has been made of sufficient capacity and strength to hold several days' supply of iron, coke, and limestone, which can be stored on it, so that in inclement weather there is no necessity for the men being exposed while bringing in supplies from the yard. An elevator of modern design is provided.

As already mentioned, one of the aims the designer of this foundry had in view was to minimize as much as possible the smoke so commonly met with, and this object has been attained by heating the core ovens by means of gas generated in a producer close to the boiler and equally conveniently situated for receiving its coal supply from the railway cars. The producer is 5 ft. 6 in. outside diameter, lined inside with firebrick, the inside diameter being 4 ft. It stands 8 ft. high, and is built on a concrete foundation. It is fed with ordinary slack, charged through the hopper on top, and consumes on an average about two cwts. per hour. It is a water-bottom producer, the clinkers falling into the trough at the bottom, and has been in continuous daily operation for a period of four months without requiring to be opened out for repairs.

The gas is conveyed from the producer to the ovens by means of a sheet-iron pipe lined with firebrick; the inside diameter is 12 in. This pipe is provided with a safety valve, in the shape of an explosion door, which, in the event of the gas becoming ignited and exploding inside the pipe, flies open, thus preventing any damage being done to the producer or pipes. Admission of the gas to the mixing chamber is regulated by means of special valve. The mixing chamber is of firebrick built inside the stoves, into which the necessary air to complete combustion is admitted from the outside. This is controlled by means of dampers hung in frames on the outside wall.

The core ovens are two in number, with arched tops. Each is 30 feet long by 9 feet 10 inches wide by 7 feet 6 inches high to the spring of the arch and 9 feet to the center of the arch. The side walls are of 14 inch and the center walls of 18 inch brickwork, bound together by means of seven buckstaves on each side, formed of old rails. These are built into the foundation of the walls on bottom, and are secured on top by 1¼-inch bolts passing through the brickwork arches, binding each pair of rails together, and forming the whole into a rigid structure proof against any ordinary strains due to heating and cooling.

The doors are of ¼-inch steel plate, well stiffened with steel angles, and are suspended from an 8 inch by 6 inch H beam erected over the front of the ovens by means of a wire rope passing through pulleys fastened to the beams and having counterweights at the ends to balance them when hoisted up. The doors are kept in position by guide rails at the sides.

One side of each of the ovens is taken up by

FETTLING SHOP, JOHN LANG & SONS' FOUNDRY.

racks. The core carriages are built of 9 inch x 3 inch channel steel, and are 10 feet long by 5 feet 6 inches wide, strongly braced on top with flat-iron bars. The wheels are of cast iron, 15 inches diameter, and are placed between the two 9 inch by 3 inch channel bars forming the sides of the core carriage. The axles run in channels formed by flat-iron straps riveted to the bottom of each side bar. This enables the carriages to be easily run in and out of the ovens.

The waste gases from the core ovens are led away through openings at the front ends provided with dampers to regulate the draft and pass on through the main flue to the chimney stack, which also serves the boiler. In addition to the large ovens already described, small core ovens of the Millett type are also provided. These are erected close to the large ovens and are perfectly self-contained, and semi-portable, so that they can easily be moved to any position found most convenient. This oven is of the following dimensions: Height, 51 inches; width, 33 inches; depth, 30 inches; area of firebox, 114 square inches; weight, 700 pounds.

The front is made of cast iron, with wrought iron pins and handles, and the sides and back are of galvanized iron, and lined with firebrick. It is provided with four swinging shelves, which may be opened or closed independently of each other. When any shelf is swung open its rear door closes the opening, thereby retaining the heat in the oven, and the drying of the cores on any of the other shelves is not interfered with. One of these doors is 5 inches high, two are 8 inches high, and one for larger cores is 18 inches high.

Electricity is used throughout for lighting the plant and the comforts and convenience of the workmen have been looked after, as is shown in the facilities provided. A well ventilated dressing room is at their disposal, where street clothes may be kept free from the dirt and smoke of the shop. The timekeeper's office is furnished with automatic recording instruments, which are used by all employes. One other indication of the desire of the owners to be of service to their employes deserves to be specially mentioned before concluding. With a view to assist the men to keep in touch with the most recent developments in engineering and foundry practice, Messrs. Lang have instituted a circulating library system, consisting of all the leading British and American publications dealing with such matters. These journals are subscribed for by the firm, and are under the charge of the foreman, who circulates them amongst the men. This privilege is much appreciated, and constitutes a practice which the majority of American foundries could follow to their own advantage.

The following rules govern the foundry of Messrs. Lang:

Fifty-four hours shall constitute a week's work, and wages will be paid weekly on Fridays at dinner-time.

Meal hours to be the same as in other departments of the works.

Two minutes before each start the whistle will be blown, when it is expected each workman will prepare so as to be ready for starting immediately the second whistle is sounded, exactly at time.

No one to stop work or to prepare to leave the shop till the whistle blows.

An allowance of three minutes will be made in coming to work in the morning; but such an allowance will not be made at meal times, and in case of deduction from time, no less than one quarter of an hour will be deducted in each particular instance.

Every employe shall endeavor to work peaceably and harmoniously with all his fellow-workmen.

Every workman shall be paid according to his ability.

Punctuality and regularity on the part of all will be considered indispensable.

Notify the foreman when desiring to be absent; and, when unexpectedly detained from work, send word as soon as possible.

Be economical in the use of all supplies.

No workman other than the furnaceman allowed on charging platform.

Spare metal must not be poured out indiscriminately through the shop, but must be brought back to furnace, and poured out in places appointed for the purpose.

Smoking, unnecessary talking, reading, whistling, shouting, and profane language are strictly prohibited during working hours.

During the meal hours there must be no frolicking nor football playing inside the works.

Be neat and clean in personal matters as well as those pertaining to the shop.

See that every tool is kept in its proper place.

Should anything occur at any time that a workman considers a grievance, the firm will be glad to talk the matter over with him, and try to get matters amicably adjusted.

The above rules are part of the contract with every person in our employment, therefore no one can complain for being discharged for the non-observance of them.

C. C. MACMILLAN.

Mixing Iron by Analyses—A Stock Company Laboratory.

In the February number of THE FOUNDRY, Mr. Hill complains, justly, about paying $10.00 for six analyses and asks if he will fix up a laboratory or continue paying for analyses in New York. In the March number, Mr. Keep replies that if Mr. Hill will send him $16.00 he will forward a measuring scale and test bar patterns by which he can with an outlay of three cents and ten minutes time each day, produce the required quality of castings. Although Mr. Hill is not a founder of wide experience, I believe he recognizes that the important part of regulating mixtures is to know what an iron is before it is charged, something Mr. Keep's method will fail to show. It is before iron is charged that we should know what it contains and not after it is in a casting. Only by a chemical analysis of pig iron and a knowledge of what the appearance of scrap fractures indicates before it goes into a cupola, can this be told. There would be just as much sense in blast furnacemen returning to their old cut and try method of charging ores to obtain desired grades of iron, as in foundrymen trying to follow the proposition presented by Mr. Keep.

It is true that some have not met with success in laboring to utilize chemistry in regulating or making mixtures of iron, but this is not the fault of chemistry, but rather the lack of knowledge of its necessities, and having proper conditions to apply it. Mr. Hill complains of the cost of analyses. He is right. Ten dollars is too much for any founder to pay for six determinations, and to think of this being increased to $100 in order to get a start and then afterward paying $5.00 per day to continue the work, is sufficient to discourage any founder in making an effort to adopt chemistry and give those who wish to deride its utility great leverage to do so.

I have originated and worked out some things, which I believe are credited with having greatly helped to make chemistry a success in founding. But there is still another plan which I wish to suggest and shall hope to see inaugurated in order to assist such men as Mr. Hill and small foundries that cannot well afford to maintain a laboratory at their own works. This is the establishment of laboratories where foundrymen in all the different sections of the country could procure analyses of their iron and castings at the lowest cost for reliable work.

To serve this end, I would suggest, as a start, the formation of a stock company, comprised of foundries located within a radius of 500 miles. This could, for example, locate a laboratory somewhere between Pittsburg and Cleveland, to cover such extremes as Chicago and New York City. The capital stock of this company need not exceed $2,000.00, and could be obtained by 100 founders subscribing $20.00 each. With 100 customers as stockholders the cost of analyses should not exceed 50 cents and may not cost more than 30 cents each. Then, instead of paying $10.00 for six analyses, from twenty to thirty-five could be obtained for the same money. On this basis, a laboratory should tender a fair profit on the investment, and in a short time, pay for itself. There is nothing to prevent such a plan being successful and could be carried on with fewer stockholders than suggested. When one has proved a success others can be started in different parts of the country, so that, in time, no founder, no matter how small his plant, would have cause to complain of the expense attached to the adoption of chemistry. For the most prompt report of analyses a telegraphic code might be utilized, thereby saving time at small additional expense.

I would gladly give the project time and money, simply for the good it could do in furthering the adoption of chemistry in founding. To assist this project, I hereby solicit any who care to take stock in such a company to write me at Sharpsville, Pa.

THOS. D. WEST.

Hardening the Face of Castings.

A process for hardening the face of castings has been patented by Morgan A. Perrigo, of Wilkesbarre, Pa. Briefly described the process consists in mixing pulverized sulphur with that part of the sand which will come in contact with the part of the casting it is desired to harden. The inventor claims that he can by this method produce a face of greater density than the casting would otherwise have had.

The foundry of S. L. Moore & Sons' Co., Elizabeth, N. J., was destroyed by fire March 18, entailing a loss of about $15,000.

The Foundry Cupola, and How to Manage It.*

BY ROBERT BUCHANAN.

The foundry cupola, considered as a furnace, is unique in simplicity of form. It consists of a vertical cylinder, lined with fire-bricks or other refractory material, having openings, called "tuyeres," by which the blast enters; a door through which the coke, iron, and limestone are charged, called the "charging door"; and a small hole at the bottom by which the molten iron is drawn off, called the "tap hole." There is also a door on the side at bottom through which entrance is made to fettle the cupola and to make repairs when necessary, and through which the kindling is put in at the beginning, and the *debris* is drawn at the end of the cast or melt. This bottom door is made up previous to the blast being put on, so as to be proof against any metal getting through. That is the cupola in its simplest form, as used in hundreds of foundries today.

The modifications of the short, vertical cylinder, with two blast pipes, which have had any permanence are these: (1) Heightening the cupola, by increasing the distance between hearth and charging door. (2) Having a blast belt, and connected with the blast belt double and sometimes triple rows of tuyeres. (3) Internal modifications of the sections of cupola containing the tuyeres, by which the blast of air reaches the centre of the fuel forming the bed.

Before lifts or hoists were in general use founders necessarily had to keep their cupolas sufficiently low, so that pig iron, scrap iron, coke, etc., could be elevated to the charging platform by manual labor. This system obtains in many foundries today. These are necessarily compelled to use short cupolas.

The introduction of hoists made the lengthening of cupolas between hearth and charging door a simple matter, and so the advantages due to such lengthening could be readily obtained. These advantages are principally the utilizing of the heat not directly expended in melting to heat the descending charges of iron about to be melted, and in keeping a cool charging door for the men to work at.

The increase of distance between hearth and charging door brought into effective use double and triple rows of tuyeres, with the better distribution of blast, more rapid combustion, and quicker melting.

Double rows of tuyeres may be used, of course, on cupolas measuring 8 ft. to 10 ft. between hearth and charging door, but in such the waste heat going up the stack would be excessive.

Double or triple rows of tuyeres must be accompanied by increased height, so that the heated gases may part with the greater proportion of their heat before finally going up the stack.

If we consider the modifications in the interior of cupolas, we shall find that almost the only change which has taken place relates to the portion immediately above the hearth and terminating a few inches above the upper tuyeres.

At this point there is an increase of diameter, and this is carried in a straight line to above the charging door. If any taper be given to the cupola lining it should be in favor of an easy descent of the charges. That is, the diameter of the cupola at the charging door should never be greater than what it is further down. Although built straight, a gradual increase of diameter from charging door to melting zone takes place in all cupolas, caused by the abrasion of the solid iron upon the heated brickwork, and by the heat of the melting.

There is a common belief amongst foundrymen that the contraction of a cupola at the tuyeres is primarily intended to reduce the quantity of coke necessary to form the bed for the first charge of iron. ** That is a very important function, no doubt, and not to be undervalued, but the greatest benefit obtained is that of getting the blast right to the centre of the cupola. This results in a very intense and rapid combustion over the whole area of the circle, and not simply a local combustion in front of each tuyere. In lining such a cupola, and afterwards in fettling it, care has to be taken that the change from the small to the large diameter is made with a gradual slope and not by a sudden change from the one diameter to the other, thus forming a circular shelf on which the descending coke may hang and so leave the space in front of the tuyeres hollow. In such a case the result would be a "bunged up" cupola. This is caused by the slag being cooled by the blast, with the result that it solidifies across just where the reduced diameter begins.

For successful work the slag in all cases must retain its fluidity as it drops past, and away from, the cooling action of the blast.

The reduction of diameter mentioned is

*Paper read before the Staffordshire Iron & Steel Institute.

**The author here refers to cupolas of the "Ireland" type, in common use throughout Great Britain and the Continent. This style of cupola has never secured any permanent foothold in American foundries.

really a lengthening of the tuyeres towards the centre of the cupola, and we get an intense combustion, beginning four to six inches above the top tuyeres, if two or more rows of tuyeres be in use, and extending over all the circular area of the cupola.

A double row of tuyeres gives the necessary tuyere area for the entrance of the blast, and will melt more quickly than tuyeres of equal area congregated at one level.

The higher tuyeres supply the necessary oxygen for the combustion of the carbon monoxide generated immediately above the lower tuyeres, the completed combustion taking place in the melting zone.

The melting zone of a 36-inch cupola, with two rows of tuyeres and blast pressure of 8-oz., begins at about six to eight inches above the upper tuyeres, and extends vertically for twenty-four inches and then terminates abruptly.

One row of tuyeres of suitable area will melt perfectly hot iron, but will do it much more slowly than two rows of tuyeres.

Two rows of tuyeres melt hot and fast.

Three rows of tuyeres will also melt hot and fast, but the upper or third row cuts up the lining badly and necessitates a deep bed of coke. Some maintain that no harm is done, although these upper tuyeres have no coke in front but blow onto the iron. The idea is that the carbon monoxide which may be escaping from the melting zone, unconsumed, is met by this stream of air and is burned to carbon dioxide, and the economy of complete combustion obtained. It is doubtful if complete combustion in the cupola is wholly economical. On the contrary, a margin or slight excess of free carbon monoxide will ensure that the oxidization of the iron and the metalloids we value present in the iron, is reduced to the lowest degree possible. If a third upper row of tuyeres is to be used, then the pipes leading to such tuyeres should be of very small diameter—not exceeding one inch, and should connect to a tuyere of 2½ in. to 3 in. diameter, so that the air may enter the cupola at reduced pressure and thus minimize the cutting action of the flame at that place. The disuse of a third upper row of tuyeres does not affect the consumption of fuel adversely, retards the melting speed but slightly, and avoids a very rapid destruction of the lining.

The appearance of the flame at the charging door, when melting is being done, is an excellent index as to whether the cupola is being worked to the best advantage. The cupola stack or chimney should be of sufficient area and height to take away all the escaping gases and flame from the charging door, and so help to make more comfortable the charging of the cupola, which, under the best conditions, is always a laborious operation.

The cupola should be high enough between the upper tuyeres and charging door to allow the ascending flame and products of combustion to part with their heat to the descending charges of iron and coke. Except during the final 25 or 30 minutes, when charging has ceased, the lining of the cupola at the charging door should not be hotter than a black-heat, or, at most, a dark-red heat.

There should not be, as is so often seen, a continuous flaming up through each topmost charge put on. This continuous flaming through is to be avoided as being a waste of heat. It is a combustion which should take place very much further down the cupola, and is indeed only rendered possible by the charges of coke being sufficiently large to stand this waste of heat and yet have enough calorific power left to do the work required in the melting zone. It is a "consummation devoutly to be wished" that the coke would descend, only gently warmed, to within two feet of the melting zone, there to begin to redden up ready for the work of melting, shortly to begin. For coke to get red hot, perhaps eight feet above the melting zone, is a gross waste of fuel, heat, and money. In hot weather it also renders the position of the men charging the cupola almost unbearable.

We may also attribute the flaming through the upper charges to deficient blast, or blast badly distributed, and the same result will ensue with a cupola which is too short. There may be flame in the stack immediately above the charging door; in fact, there usually is such a flame, but the heat from it causes little inconvenience. This flame is the burning of the carbon monoxide, probably from the incandescent coke just above the melting zone, and is characterized by being of a bluish-pink color, the flame clinging to every little projection and ledge in the chimney stack. When the flame in the chimney is of this bluish-pink tinge, the blue predominating, the flame clinging to the chimney wall as mentioned, now and again running down and burning at an opening in the charge in a ragged sort of way, then it is scarcely necessary to look at the metal being drawn from the cupola. Such an appearance at the charging door always betokens that good melting is being done. A

flame of a whitish-yellow color, extending through the charge and up into the chimney, and often out at the top of the chimney, and without the ragged appearance of the proper flame, indicates that too little air is being blown into the cupola. This flame may be seen in a cupola with proper blast any time the cupola-man opens a tuyere to clear away any obstruction there may be in front of the tuyere, and so allows some blast to escape, thus temporarily reducing the blast pressure. This flame is also an indication of scaffolding or other obstruction to the free passage of the blast. When this flame appears, and the blast gauge indicates a rise of pressure, then it is well to see if scaffolding has begun.

The appearances thus roughly indicated are such as apply to a cupola measuring 14 to 15 feet between tuyeres and charging door, and give, as indicated, a good idea of the general conditions obtaining in the cupola at the particular moment.

The total tuyere area to be economically employed is conditioned by the diameter of the cupola, the blast pressure available, and the density of the coke used.

Whatever be the diameter of the cupola, it is desirable to have the blast effective over its whole area. If the diameter be large, then a higher pressure of blast with a reduced area of tuyeres may be used effectively to reach the centre of the cupola; but the coke must be hard and dense to be satisfactory under such conditions. With a softer coke the tuyere area has to be enlarged so that the proper volume of air may enter in a given time. This stream of air being slower moving, and having a larger surface contact as it enters the cupola, has not such an abrasive action on the incandescent coke as the stream from a small tuyere has, but neither has it the penetrative power of the latter.

Should the tuyeres be set for high pressure of blast and dense coke, and coke of low density be delivered by the makers, as will sometimes happen, it is best to blow with less pressure. Melting will be slower, but the cast may be got through, though later than usual. Hard blowing with soft coke results in the bottom part of the cupola in front of the tuyeres being blown hollow, a solid roof of set slag a few inches above the tuyeres, a "stuck" cupola, and a general mess. There is no single thing which can happen in foundry operations which so nearly affects everyone as a "stuck" cupola. It is a serious financial loss to both employer and employed, and raises a grave suspicion of the capacity of the management should it be anything but a rare occurrence. On the other hand, there is room for just a little legitimate pride when one has mastered the varying conditions attaching to cupola melting, and made the cupola a willing slave answering to every call made upon it.

The total tuyere area to be used on a cupola is given by West, an American foundryman, as not to be less than one-ninth the area of the cupola. That is a rule which does not err by being too small a proportion. No general rule, however, can be given for all conditions of diameter and height of cupola pressure of blast, and character of coke used. The most suitable tuyere area for a particular cupola may only be obtained by trial. The suitability of the particular tuyere area adopted is to be judged by the results as a whole, which should embrace as the most important parts, hot, fast, melting with the smallest quantity of fuel.

Cupola shells, unfortunately, have often much too small an opening for the passage of the air from the wind belt into the interior of the cupola. These openings in the inner shell should be amply large. It is easy to lessen the tuyere area if it be thought well to do so, by making the opening in the brickwork less than the opening in the shell. If, however, one wants to blow with a 5-in. tuyere, and the opening through the shell is only four inches, there is an unnecessary trouble and expense in making the trial.

The doors on the air-belt opposite the tuyeres should also be ample in size, being not less than six inches in diameter, with a two-inch opening in the middle of the large door, this opening being covered by a small door conveniently hung, so that the tuyeres may be poked as occasion requires, without having to open the large door, and so allow an unnecessary amount of blast to escape. The small door may also be used as a peep-hole to see that the tuyeres are clean. The glass and mica usually seen on tuyere doors soon break, or become opaque, through the impinging of particles of dust propelled by the blast. The use of the large tuyere doors will be seen when we come to speak of "Scaffolding."

The height which tuyeres should be above the bottom of the cupola is fixed by the weight of the castings to be cast in the foundry, and also by a consideration whether a "receiver" or separate hearth is used in which to collect the metal as it is melted, or whether the iron is collected in the hearth of the cupola itself.

In the case of cupolas having receivers for the reception of the iron as it melts, the lower tuyeres may be only four inches above the bottom. The metal and slag run directly out of the cupola into the receiver as quickly as melted, and so the lower tuyeres may be as low as desired, provided that the channel-way into the receiver be just a little lower.

In cupolas where the metal is collected in the hearth of the cupola itself, and that is the way in this country in the great majority of cases, the height of the lower tuyeres, whether double or single rows of tuyeres be used, should be governed by the class and weight of castings being made, and also, to some extent, by the duration of the cast.

We have seen a description of a cupola having no separate hearth, where the tuyeres were said to be only four inches above the bottom. With such a height of tuyeres the melt would be an exceedingly small one, as the accumulated slag would speedily close the tuyeres. We have found that melting with a cupola twenty-four inches in diameter, having tuyeres twenty-four inches above the bottom, slag would sometimes appear at the tuyeres with two cwt. of melted iron in the hearth, 40 cwt. of iron having been melted and no slag run off.

A cupola with tuyeres any less than 12 in. above the bottom is only suited for hand-ladle work, and even at that height, the continuation of the melt will depend on a careful watch being kept on the slag, which should be run off at the slag hole, if there is one. If there is no slag hole, then it may be run off at the tap hole, but that is an unworkmanlike way of doing it. Every cupola should have a slag hole and it should be used.

The reason for placing tuyeres only a short distance above the bottom is, of course, to lessen the amount of coke necessary for the bed. This must extend at least twelve inches above the highest tuyere, whether single, double, or triple rows be used. It is very doubtful saving to work with tuyeres so low as to be in constant danger of getting them, and the air passages, filled with slag, and perhaps iron. There is also the risk of drawing off the pig iron and scrap in separate strata, some castings getting all pig iron and others all scrap, instead of the well-mixed iron which may be obtained from a hearth of proper depth.

If low tuyeres and a restricted bed of coke be used, then a fair measure of intelligence, skill, and alertness must be displayed at the cupola if satisfactory results are to be obtained.

BLAST PRESSURE.

Iron may be melted as hot with blast at 6 oz. of pressure as with 12 oz., but speed of melting will be reduced. The greater the diameter of the cupola the greater will be the loss of combustible gases when using a soft blast. As the diameter increases so should the blast pressure increase, so that it may reach the centre of the cupola. If there is a blast gauge it should be seen that the cupola-man is shown its use, and that he consults it. Unfortunately there are hundreds of cupolas melting today in charge of men who never saw a blast gauge, and would not know what it indicated if they did see it. There should be a blast gauge at every fan or blower, and one on every cupola. The blast gauge is an excellent telltale of how the cupola is working. If the cupola-man observes that the blast gauge is registering 5 or 6 oz. more than usual, he is not to conclude that the blower has become much more effective than usual. He should take the rise in the gauge as a danger signal, and should see if, as is most probably the case, there is a partial scaffolding in the cupola, and at once take steps to clear it.

SCAFFOLDING, AND HOW TO AVOID IT.

Scaffolding is the term used when the charges of coke and iron have ceased following down as the coke and iron previously charged is burned away and melted respectively. When scaffolding occurs in a cupola there is usually a fairly empty space in front of the tuyeres. Over the tuyeres, however, and extending almost, if not quite, across the cupola, is a roof of solidified slag and iron. Scaffolding may be due to deficiency of fluxing material, such as limestone or fluor-spar. Under such conditions the slag formed is pasty and not truly fluid, with the result that when it comes within the action of the blast as it enters the hearth it becomes solid. Poor coke, having low carbon, high ash, and low density of structure, otherwise a light coke, is a fruitful cause of scaffolding. The low carbon does not give that intensity of heat so desirable, the high ash gives excessive slag, and the lightness of structure allows the coke to be readily disintegrated, or blown away by the blast. Faulty contour of cupola lining, possibly in conjunction with the causes just mentioned, may cause, or help to cause, scaffolding. All departures from vertical lines, or where cupola linings are being drawn in at bottom, should be done very gradually, and anything in the nature of a shelf carefully avoided. Blowing a cupola with too much

blast may also cause scaffolding, but that is a comparatively rare cause where good coke is employed.

The way to avoid scaffolding is just the converse of the causes mentioned. Have ample fluxing material, say 56 lbs. of limestone per ton of iron melted. If charges are all pig iron, 40 lbs. of limestone per ton of iron melted is enough, but then, few founders use all pig iron. Use good coke, with carbon as much over 90 per cent as can be got at a moderate cost. The lessened melting power of a coke at 87 per cent carbon is very marked as compared with coke with 90 per cent carbon. It takes 27 cwt. of the 87 per cent coke to supply as many carbon units as is contained in 26 cwt. of coke with 90 per cent carbon. Ash usually takes the place of carbon in low carbon cokes, and it is a very poor substitute. The only place where it is as effective is on the weighing machine. If low carbon coke must be used, and scaffolding is to be avoided, then ample fluxing, light charges of iron, and easy blowing are the means to adopt.

If a piece of pig iron or heavy scrap has got down in front of a tuyere, it forms an excellent nucleus for scaffolding to begin. The large door in front of the tuyere provides a means by which some pieces of coal may be placed in the inner end of the tuyere, against the hottest fuel or slag there, so that the coal may begin burning. If the pig iron or scrap (it is usually a piece of pig iron) blocks the way, then it must be poked back towards the centre of the cupola, so that the coal gets alight. The tuyere is now closed, and the blast allowed to blow the lighted coal. Such a course has usually a magical effect in clearing the tuyere, as the flame from the coal is very hot. A large door to the tuyere allows the coal to be put into the tuyere by the hand. With a small door the coal has to be thrown across the air belt, with the result that about one piece in six gets where it is wanted. If the unmelted pig iron or partial scaffolding cannot be moved back by the steel bar in the hands of the cupola-man, then the tuyere should be closed by means of ganister or other suitable material, and the other tuyeres be made to melt down the obstruction. The blast should be eased while this is being done, and not put on full until, by poking a hole in the tuyere closed with ganister, it is seen the obstruction has gone. The tuyere may now be fully opened, and the blast put on with full force, and melting proceeds as before.

If several tuyeres have got black, and the obstruction cannot be moved by poking, nor by adding coal, nor by stopping tuyeres, you may conclude that the cupola is in a "parlous state." In such a contingency shut off the blast at once, as more air is only cooling the cupola, and making it more difficult to get the coke and iron out. The cupola-men may now experience the delights of getting the coke and iron, some of it half melted, out of a "bunged" cupola. Fortunately, it is a very satisfying kind of pleasure. One experience of the kind perfectly satiates all engaged in it, and there is no longing for a renewal of the joys which always accompany a "bunged" cupola.

Putting extra limestone or other flux on the topmost charge is of use only if the scaffolding is cleared and melting is proceeding; in this case the added limestone as it reaches the melting zone will render the slags being formed there more fluid, and so help to clean down the walls of the cupola. When the cupola is cleared of the unmelted charges there is always a good quantity of slag and iron adhering to the lining of the cupola. If the cupola has to be fettled next morning, the cupola-men with anxious forethought as to how hot it will be, will sometimes, if allowed, throw quantities of water through the charging door onto the hot brickwork and thus ruin the lining. A better plan is to close the charging door for the night, and allow the air to travel the whole length of the cupola from bottom to top. Leaving the charging door open in the expectation that it will let out some of the heat is a mistake, it only spoils the draught to be obtained by the unbroken continuity of cupola and chimney.

It may be useful to compare the relative drawbacks and advantages of cupolas which have solid bottoms, collecting the metal in their own hearth, and those having drop bottoms, and having separate hearths or receivers. Cupolas which have solid bottoms and collect metal in their own hearths are less expensive to erect, less costly in upkeep of lining, etc., and require less fettling daily. The coke has to heat up, say 30 cwt. less of brickwork than in the case of a cupola having a receiver, and so has that heat to bestow on melting. A given quantity of coke should thus produce hotter metal at the tap-hole of a self-contained cupola than will be tapped from one having a receiver, and this is undoubtedly the case.

The tuyeres of a self-contained cupola, however, as already pointed out, have to be high enough to allow a body of metal to be col-

lected in the cupola, and this causes the bed of coke to be higher than is necessary in a cupola having a receiver.

Contracting the cupola in the region of the tuyeres so as to get blast penetration also reduces this capacity for holding a quantity of molten iron. In this respect the cupola with a receiver has an advantage. No metal being collected in the cupola the size at bottom may be reduced very considerably, and so the coke used for the bed may be lessened accordingly.

Cupolas having receivers allow a more perfect mixing of iron, as a large quantity may be collected in the receiver with no risk of having trouble with iron or slag getting into tuyeres. This collecting and perfect mixing of the iron is the outstanding advantage of the use of a receiver, and renders possible the drawing in of the cupola as mentioned. It has no other advantage. Besides, the channelway or connection between cupola and receiver, through which all the iron and slag flow, is a distinctly tender part. A deep groove gets worn in the bottom of the channel each melt. If a crack develops and the metal begins to come through, and in doing so proceeds to cut up the iron casing, it is almost impossible to go on melting.

We have found it best not to run the metal along the main connecting brick. By bedding good fire-bricks end to end along the channel, and renewing these as they get worn out, a very much longer service is got from the main brick. Should the metal get between the joints of the bricks it can get no further than the connection or main brick on which they lie. Should the connection brick get cracked, say by a movement of the receiver, and in heating and cooling this is not unusual, then by making one of the fire-clay bricks to span the crack, the connection brick may be made to do service until it can be suitably replaced.

To sum up in a few sentences what has been stated, a cupola which collects the metal in its own hearth will melt metal more economically than one having a receiver, but will require higher personal skill in management to produce well-mixed iron. A cupola having a receiver, takes more fettling to keep in order, is not so economical of fuel, having a larger body of brickwork to heat up, but gives more perfectly mixed iron.

Cupolas with drop bottoms are not very common in this country, most founders preferring those with solid, brick-built bottoms, the coke, slag, etc., being drawn out at the side door at bottom, at the conclusion of the cast. Some who have had drop bottoms to their cupolas have even discarded them and built solid bottoms instead. Drop bottoms are in almost universal use in America.

Drawing a cupola by the side door at bottom, at the conclusion of a cast, as is necessary in cupolas having solid bottoms, is laborious, hot work at the end of a hot day.

With a drop bottom the contents of a cupola may be withdrawn in two minutes without any effort worth mentioning. On the other hand, the drop bottom has to be made up each day, and made up carefully and well. A solid bottom cupola requires practically no making up whatever. When metal happens to make its way down through the folding doors of a drop bottom, as will sometimes happen, there is no necessity to drop the cupola. As a general rule shutting off the wind and stopping melting permits repairs to be made and the leak stopped so that the heat can be finished.

One material advantage the drop bottom has over the solid bottom is when more iron has been charged into the cupola than is necessary to cast the work then on the molding floor. When all the iron required has been tapped out, the blast may be turned off and all the unmelted iron and unburnt coke in the cupola dropped, the coke being carefully quenched, to be used again the following day. In such a case when using a cupola with solid bottom the cupola-men almost always melt the iron and pour it on the floor. It has then to be broken up, is accounted as scrap and is charged into the cupola as such. The coke used in melting this excess iron is consumed, of course, and is not again available.

The cupola-man's motive for doing so is not to waste the coke or iron, but is simply that for him, the easiest way to get out of a solid bottom cupola, iron which is already in, is by melting it out.

Charging exactly the quantity of iron required is excellent foundry practice, but having 1 cwt. less than is required is very bad practice indeed, and may result in the "pouring short" of an important casting. If there is any doubt of the quantity of metal in the ladle being sufficient for the mold to be cast, and no more is to be had, then do not hesitate to pour the metal into pigs made in the floor. It is the stupidest of proceedings to follow an error in judgment at the cupola, by turning a good mold into a very indifferent pig bed. That is what is done when a mold is poured with too little iron, and is not at all an unknown thing in foundries.

A few hundredweights of iron in the cupola in excess of the probable requirements are thus used as a factor of safety, and, as already pointed out, the drop bottom allows this margin of safety to be obtained at the cost only of picking out the iron and coke from the *debris* of the cupola and elevating it to the cupola platform.

One additional advantage the drop bottom has, is the easy access it gives to the interior of the cupola for fettling purposes. There is thus a clear balance of advantage in favor of the drop bottom as compared with the solid bottom cupola, for ordinary foundry work.

CUPOLA MANAGEMENT.

Iron may be melted with a very low ratio of coke to iron, and yet not be economically melted. If the iron is not fluid enough for the particular work to be cast, then a small consumption of coke per ton of iron melted has been waste and not economy.

Cupolas are too often left to be managed by practically unlettered men, to whom "use and wont" is the only safety, and deviation spells disaster. To look to such for an advance in cupola practice, is folly. One of the things we hope the future contains, is, that no one shall be put in charge of a foundry who cannot himself, in some considerable degree, supply some of that higher knowledge which fate or providence or whatever you will has denied to those under him.

An important quality necessary in one who aspires to successful cupola management is a knowledge of the material with which good results are to be obtained. For this purpose he should know the general effect of the several constituents present in pig and scrap iron, the modifications which these undergo during their passage down the cupola, from the solid to the molten condition, and the effect of the constituents upon the general condition of the casting produced. It is here that the chemist and founder may co-operate towards that desired end. Chemistry may not be an infallible guide nor may it account for some of the unexplained phenomena seen in the manipulation of iron into the finished product, but it will certainly prove of help in many instances.

Is the fracture of pig iron a guide to its quality? The reply is "Yes" and "No." Fracture has been, and is now, the only guide which most founders have regarding the quality of the irons they use. However, it is inevitable, we believe, that, judging pig iron by fracture shall give place to the more precise test of analysis. Physical structure may sometimes differ in irons of similar analysis and discordant results follow tests of these irons, but the broad fact remains that in the very great majority of cases the same physical effects follow the same chemical constitution.

Analysis shows the vagaries of the numbering of iron. The No. 1, No. 2, and No. 3 of one maker are not the No. 1, No. 2, No. 3 of another maker, and sometimes to help to complicate matters one maker's irons will change numbers and each personate the other. Why should there not be a chemical test for each cast, and sell on that test? Founders have a right to expect that a pig iron of a given brand and number should have some consistency of character, yet we all know from experience that such is not the case. Such differences may be unavoidable in blast furnace practice, but the iron founder must recognize that they exist. Knowing the chemical contents of the iron, the manager of the cupola is helped to produce, with a regularity obtainable in no other way, a mixture of iron in which is found the qualities necessary for the work in hand. If he has no definite data, how can he produce definite results?

Coke should also be bought by analysis, supplemented by due attention to density of structure. Ash and sulphur should be as low as can be obtained, and even in coke of good reputation these vary considerably. Taking ten analyses of coke the results were as follows:

	Sulphur.	Ash.
Lowest percentage	0.530	6.520
Highest percentage	1.068	10.300
Average percentage	0.769	8.604

The coke with 1.068 per cent sulphur caused much trouble by hardening the castings. Coke with 90 per cent carbon may be considered satisfactory in this respect. Carbon should not be allowed to drop below 86.5 per cent, as even at this percentage a marked difference in the melting power is noticeable, as may be expected. Coke with 91.78 per cent of carbon is the highest carbon we have met with.

Limestone used for fluxing should also be analysed, as a small difference in composition may alter considerably the character of the slag either in the molten condition or when hard and adhering to the lining of cupola and ladles.

ANALYSES OF LIMESTONE.

	(1)	(2)
Calcium Carbonate	98.02	95.01
Magnesium	1.05	.....
Silica	.43	4.16
Alumina	.20	.40
Oxide of Iron	.23	.43
Oxide of Manganese	.07	.....
	100.00	100.00

The limestone marked (2) formed a slag remarkable for the difficulty with which it could be detached from the walls of the cupola and receiver when chipping down preparatory to fettling for another cast. The limestone marked (1) is superior to the other in respect of the high percentage of calcium carbonate and comparative freedom from silica.

SCRAP IRON.

In mixing iron according to the anaylsis of the several irons to be used, the scrap iron coming from the foundry as gates, rejected castings, etc., is readily classified as to its position, being similar in analysis to the castings produced. Bought-in scrap from its miscellaneous character forms the most doubtful part of the whole. Heavy machinery scrap may be considered as having silicon 1.8 per cent, phosphorus 0.8 per cent, sulphur 0.11 per cent. Miscellaneous light or medium scrap may be considered as having silicon 2 per cent, phosphorus 1.2 per cent, sulphur 0.11 per cent.

In the sample mixture given, silicon, phosphorus, and sulphur are taken as being the constituents of greatest importance in the castings designed to be made. In some classes of work other constituents may rise into prominence, and one or other of these may be relegated to a position of secondary importance. This sample mixture, by the analytical method, is chosen not because it is particularly accurate, but is given as an exact representation of what may be done in daily work.

	Estimate.	Analysis.	Difference.
Silicon	2.445	2.519	0.074
Phosphorus	0.959	0.868	0.091
Sulphur	0.099	0.104	0.005

By making mixtures in this way one can usually get very near the exact constitution of the product so far as a chemist can reveal it. One could not have the same exactitude mixing irons by fracture. There is also this immense advantage to the founder. He is not tied to the use of any one make of iron, but may make his mixtures with confidence, whatever the name or brand, so long as the combination yields the requisite percentage of each constituent.

The use of testbars is a valuable adjunct to such a system of mixing. Both testbar and analysis will be found to have a very vital relationship, of which indeed there is abundant proof, and so requires no further consideration at this time.

Having begun the mixing of iron as shown, it is continued by the pig-breaker. Where several stacks of one brand of iron are in the yard, these having come in at several different times, will represent very probably several casts at the blast furnace. Each day's requirements should be drawn from several of these stacks that a truer average quality of the iron may be obtained. Another good system is to lay one long layer of pig iron from the first

SAMPLE MIXTURE.

Pig Iron.	Cwt.	Silicon.	Total Silicon.	Phosphorus.	Total Phosphorus.	Sulphur.	Total Sulphur.
Holwell No. 3	2	3.546	7.092	1.141	2.282	0.029	0.058
Stanton No. 2	2	3.826	7.652	1.092	2.184	0.025	0.050
Barrow XXX	1	1.959	1.959	0.285	0.285	0.070	0.070
Hematite	1	2.250	2.250	0.045	0.045	Trace	Trace
Scrap	4	2.000	8.000	1.200	4.800	0.110	0.440
	10		26.953		9.596		0.618

To get the average silicon divide 26.953 by 10 and deduct 0.25, being the average amount of silicon loss, in the course of one melting of iron. To get the average phosphorus divide 9.596 by 10, but as phosphorus does not lose or gain anything in the course of melting, nothing is added or deducted. To get the average sulphur divide 0.618 by 10 and add 0.038, being the average gain of sulphur in the course of one melting. The figure 10 represents, of course, the number of cwts. making up the charge. The result, as checked by the analysis, is as follows:

car; on top of that put the pig iron from the next car and so on. Then begin using at one end and work from top to bottom. Thus the pig iron is getting well mixed before it reaches the cupola, and helps considerably to regulate the quality.

CHARGING THE CUPOLA.

We shall take it that the bottom of the cupola is in good order, the inside contour of lining free from sudden changes of diameter or projecting knobs of slag, which may hinder the regular descent of the charges of coke and

iron as melting proceeds. The first thing to do is to ascertain the depth of bed necessary to begin the melting. It is the upper part of the bed which melts the first charge of iron. The coke in front of the tuyeres does not melt the iron, unless it be indirectly.

When the blast strikes the coke immediately in front of the tuyeres, carbon dioxide, or carbonic acid, is formed. The carbon dioxide so formed, passing up through the next layer of incandescent coke, is immediately reduced to carbonic oxide, which, combining with the free oxygen of the blast, produces the intense heat of the melting zone and passes up the cupola as carbon dioxide. There is also some unconsumed carbonic oxide which escapes up the cupola, and is to be seen burning in the chimney or stack. The presence of unconsumed carbonic oxide in the cupola is not altogether an evil, as it prevents, in some degree, oxidation of the iron. The melting zone is the section of the cupola where the combustion of the carbonic oxide is practically begun and completed with the production of a most intense heat.

The region of highest temperature, as indicated by the wear of the lining, is at the top of the melting zone. The position and depth of the melting zone is fixed by the quantity and pressure of blast used, but may vary to some extent as tuyere area and cupola diameter vary.

It is a most important fact to remember that no actual melting takes place until the metal reaches the top of the melting zone, no matter how much coke is put on above the zone. Were it piled four feet high, the coke is simply burned away until the iron gets down to the melting zone, where it changes from the solid to the liquid state, and so drops to the hearth.

Not any more coal than is actually necessary should be used in kindling, as ordinary coal usually contains more sulphur than is desirable, and tends to harden the first iron melted. Many cupola-men make the mistake of over-burning the bed before making up the bottom door and beginning charging.

The bed requires to be kindled as high as the tuyeres, and that only, and charging the iron may begin. The pig iron, which has been broken into four pieces, if for a cupola of over 30 inches diameter, or into six or eight pieces for lesser diameters, is weighed and charged into the cupola. It is a good plan to put a thin layer of scrap on the top of the bed to keep the solid pig iron from smashing the upper layer of coke. Then, after the pig iron, the remainder of the scrap is charged and evenly distributed over the cupola. On the scrap is now placed the charge of coke, also evenly distributed. Some limestone, to flux the ash of the coke and the sand adhering to pig iron or foundry scrap, is now added. Some cupola-men, however, do not begin adding limestone until the first charge after the cupola is filled up, but I fail to see any advantage in this.

The charges as stated are continued until the cupola is full to the charging door. It is important that the coke occupies a distinct stratum between the charges of iron, as only by this means is the bed kept level as melting proceeds. Projections inside the cupola may also tilt a part of the charge, and so cause an irregular descent to the melting zone. Level charging, and a level descent of the charges, go a long way towards satisfactory melting. When the cupola has been charged to the charging door, the blast may be put on as soon as is convenient. Some people advocate a period of one or two hours as a proper time to elapse between finishing charging and putting on the blast.

We have found no inconvenience whatever in blowing as soon as charging is finished, if the bed is kindled to the tuyeres, and no cupola should be charged unless it be kindled to the tuyeres. Blowing quickly after charging will give hotter first metal than what is got with a longer interval of time. When the coke is called upon to give up its heat, it should do so rapidly, and with its whole vigor, and should not be employed in "warming the charge," as it is termed.

The quantity of coke put on between the charges should only be sufficient to keep the bed level with the top of the melting zone. When a charge of iron has been melted, and the layer of coke has followed down by reason of the weight of iron and coke on top of it, if the coke be too great in quantity, and more than replaces the coke consumed in melting the iron just liquefied, the result is a partial cessation of melting until the excess coke is burned away, and the iron is down to the top of the melting zone. By the time the charge of iron has melted, the fuel in the melting zone will have sunk a distance which depends on the weight of the charge of iron melted. The charge or layer of coke which follows should just exactly fill the space vacated by the coke used in melting the previous charge.

Were the important facts understood: that iron is melted only in the melting zone; that coke intervening between it and the melting

zone is simply burned away; that the sinking of the incandescent fuel in the zone wants replacing and no more, then melting would be more rapid and very much more economical than it usually is at present.

It will readily be understood how it is that charges of coke which are too large cause the melting to be slow and hot. Slow because the iron cannot get down quickly enough to the only place where it can be melted, and hot because of the excess of fuel. The excess fuel, for want of something better to do, cuts up the lining usually.

Each cupola may be put upon the best melting conditions only by trial. To do so, in the morning, before fettling is done, look for the melting zone of the previous day. Measure the distance from top of zone to sill of charging door. Saw a length of wood a foot shorter than the distance found. Charge the coke until the piece of wood, resting one end on the coke, comes just level with the sill of the charging door. The coke has been weighed, of course, and it will be found that it takes more coke each day, as the lining wears, to bring the bed up to the same height as tested by the measuring stick.

A thorough fettling each week brings the cupola back to the original form, and so there is soon established a system of regular height of bed. Do not let the cupola-men depart from weighing the bed and all charges of coke. They may profess to know the weight they shovel on, but they don't.

If the melting is hot and slow, then the charge of coke on the top of each charge of iron is too large, which will be confirmed by too much flame of a luminous character at the charging door.

Reduce the quantity so charged, say, 28 lbs. each charge, and continue for a day or two charging the same way. If the metal is hot, and probably faster melted, again reduce the coke by another 28 lbs. per charge, and so continue until the danger limit is reached. This will be indicated by the metal getting dull at the end of the melting of one charge and hotter at the beginning of the next. This will not go on long, as the bed is now being called upon to contribute more to the melting than what is being replaced by the charging of coke reaching it. The last deduction of coke should now be replaced and so continued.

The metal should now be of a regular heat, quickly and economically melted. When melting down the last two charges of iron, reduce the blast to half-pressure. It does not retard the melting appreciably, saves the coke remaining in the cupola, and avoids wasting the lining. More linings are wasted in the last 15 minutes' blowing than for hours previously.

The following is the system for charging a 36-inch cupola, two of which, as well as a smaller one on special work, are in use at the Soho Foundry of W. and T. Avery, Ltd., Weighing Machine Manufacturers, Birmingham:—Inside diameter of cupola, 36 in., contracted to 19 in. at bottom. Height, bottom plate to charging door, 15 feet. Two rows of tuyeres of 78 square inches total area. Melts over 4 tons per hour, and 20½ tons have been melted in it in one afternoon. Each cupola has a separate hearth or receiver for collecting the iron as it is melted. From the receiver the metal is tapped into the ladles.

The system of charging may be best followed by beginning at the bottom and reading up.

Charge 10 cwt. Iron Charge 1 cwt. Coke	and so on, until after the second last charge of iron, when only 56 lbs. of coke is put on.
Charge 10 cwt. Iron Charge 1½ cwt. Coke	Cupola is full to charging door, when 50 cwt. of iron is in.
Charge 10 cwt. Iron Charge 1½ cwt. Coke	
Charge 10 cwt. Iron Charge 1½ cwt. Coke	Blast pressure 8 to 10 oz.
Charge 10 cwt. Iron Charge 1½ cwt. Coke	
Charge 10 cwt. Iron Bed 5 cwt. Coke.....	24 to 28 lb. of limestone put on top of each charge of coke.

The average expenditure of coke over a period of one month is as follows:—

For light castings	1 lb. of coke melted	7.87 lbs.	of iron.
For heavy "	1 lb. "	10.00 lbs.	"
Average for month	1 lb. "	8.49 lbs.	"

The light castings are debited with the bed of coke. After the cupola is charged level with the charging door, the coke charged is at rate of 2 cwt. per ton of iron charged, excepting the last coke put on, which is only 56 lbs. between the last two charges of iron.

Metal appears eight minutes after the blast is put on, and is hot enough throughout the heat to run castings sometimes under one-eighth of an inch in thickness, molded and cast at a distance of 250 feet or thereby from the cupola.

MELTING RATIOS.

This is a subject which probably interests foundrymen more than any other, and in regard to which there is considerable romancing by cupola makers and some others. Some of the absurd claims as to economy of fuel, would only be fitted to make one smile did one not know that these questionable statements too often mislead to a serious extent people with capital invested in foundries. Their acquaintance with melting is not such as enables them to judge of the case, and so they accept these statements as authoritative.

Such misleading claims only cause trouble and annoyance for people who have the melting to do, and disappointment for those who employ them.

When absurd claims are made, say of melting 16 lbs. of iron with 1 lb. of coke, one wonders what was done with the metal when it was melted. Did it run castings? That is the object for which iron is melted. What was the proportion of defective castings? It is as important to know the answer to these questions as to know the proportions of iron and coke. We believe metal may be melted in the ratio stated, but we do not believe the castings of an average foundry can be run with the metal. What then is a good, that is, an economical ratio of coke to iron? It cannot be stated in one word. What is good and economical melting under one set of conditions may be waste under another set of conditions. Condition of cupola, volume of blast, quality of coke and of the iron to be melted, kind of castings to be run, and distance the metal has to be carried, are all important matters affecting the answer.

An economical melting ratio is one which, under the prevailing conditions, shall produce with the smallest quantity of coke, metal suited for the work to be cast. Can all cupolas as now worked be considered as having economical melting ratios? Investigation would show, we have no doubt, that the number on which no improvement may be made is a small minority indeed.

EFFECT OF CUPOLA MELTING UPON THE IRON.

That iron undergoes some changes, other than being melted, in its passage from the charging door of the cupola to the foundry ladle, is known to most founders. Silicon always gets oxidized to some extent, losing .20 to .30 per cent each time the metal is melted. Manganese loses on an average .093 per cent each time the metal is melted. The smallest loss we have observed is .056 per cent, and the greatest .134 per cent. The manganese in the castings averaged .259 per cent.

Phosphorus goes through the cupola practically unaltered in quantity. Blast and flux have little effect upon it, and one sometimes wishes they had more. The only phosphorus which passes into the slag seems to be that present in the iron which is oxidized, and goes into the slag taking its phosphorus with it.

Irons containing one per cent and over of phosphorus have great fluidity and running power, so that thin castings may be run with an iron of this character with great facility. The fluidity and running power of such iron is due to the low melting point of phosphide of iron, which is the condition in which phosphorus is present in iron. This melting point is several hundred degrees of temperature under that of the iron which envelops it, and through which the phosphide is interspersed. At the moment the iron melts, the phosphide has risen several hundred degrees above its melting point. This fact supplies the reason why phosphoric irons run with such fluidity; the phosphide having to cool down through many degrees of temperature, lower than the "setting" or freezing point of iron free from phosphorus, before reaching its "setting" or freezing point. The cooling action of a mold has thus an effect on low phosphorus iron which it fails to have on phosphoric iron. Iron containing phosphorus is thus easier melted than non-phosphoric iron, because it melts and is fluid at a lower temperature. Iron containing .20 per cent of phosphorus we may term a low phosphorus iron. Iron containing one per cent and over we may term a phosphoric iron.

Sulphur is the source of much trouble to the iron founder, hardening castings very considerably if .14 per cent be present, and at .15 per cent. the iron is too hard to machine. Coke, with sulphur averaging 0.769 per cent, increased the sulphur in the castings as follows: Minimum, 0.020 per cent, maximum, 0.079 per cent, average, 0.038 per cent. The average is that of twelve meltings. As sulphur increases in the coke so will it increase in the casting. The importance, therefore, of using coke with little sulphur cannot be too much emphasized.

If the cupola is melting dull iron, a greater proportion of sulphur goes into the iron than when hot melting is being done. The first iron from a cupola, not being so hot, usually, as that melted later, is higher in sulphur, and so such iron is poured into castings with little or no machining to be done on them. If the cupola melts dull all through the cast, then the iron will, from this cause, be hard all through the cast. This absorption of sulphur by dull iron is evidently due to the slag being viscous or pasty, and in such a condition has a feeble combining or basic effect on the sulphur. Slag has a higher melting point than iron. The iron on melting combines with the sulphur, forming sulphide of iron, at a temperature under that of fluid slag. If hot melting be done, the sulphur passes into the slag in greater proportion, not because the iron is hot, but by reason of the slag being fluid and so intimately comes in contact and combines

with the sulphur-bearing ash of the coke. Thus it is that hot melting makes soft castings. Combined carbon and graphitic carbon need not be considered as being specially affected by melting. The respective amounts to be found in the castings are due more to the other constituents present and also to the cooling conditions of the castings rather than to any action which takes place in the cupola. Carbon, as a whole, is reduced in quantity in the course of melting, but an increase of total carbon is not unknown. However, we believe this forms the exception to the rule. The loss of total carbon in one melting will probably range from .130 to .140 per cent.

CUPOLA SLAG.

There is a section of cupola practice which has not had the attention it deserves. There is more iron, not visible to the eye, carried to the rubbish heap than most people imagine. So long as cupola-men get a fluid slag, the iron chemically combined with the slag does not concern them, principally for the reason that few of them know there is iron in the slag, unless it be visible. Slags may contain over 10 per cent of iron. The lowest quantity of iron in any slags we have had analyzed being 1.90 per cent, and the highest 10.10 per cent.

Taking nine analyses of slag, some of which analyses were averages of three to four meltings, and would thus represent about 20 meltings, results were as follows:—Average of iron, 4.690 per cent; sulphur, 0.270 per cent; phosphorus, 0.049 per cent. Silica averaged 57 to 58 per cent, and was the product of sand adhering to the pig iron and foundry scrap, and also from the lining of the cupola.

Increasing the quantity of limestone charged does not seem to decrease the percentage of iron, nor to increase the sulphur and phosphorus passing into the slag in any appreciable degree. Thus, with lime at 0.60 per cent in the slag we found sulphur 0.219 per cent and phosphorus 0.042 per cent. With lime increased 22.61 per cent, the sulphur is increased 0.001 per cent, and the phosphorus 0.008 per cent.

These are very small quantities indeed when compared with the effect one might expect with lime increased from 0.60 to 22.61 per cent. The slag, with 10.10 per cent loss of iron, had also the greatest amount of phosphorus (0.16 per cent), showing that the iron in combining with the slag had taken its phosphorus with it.

It has been already stated that when iron is being melted dull, that is coming out of the cupola at what we may term the "red-molten" condition, a greater quantity of the sulphur goes into the iron than when hot melting is being done. This we explained as being due to the formation of sulphide of iron at a temperature at which the slag was pasty or only partially fluid. Although slag has been fluid in the cupola, and has taken up the normal quantity of sulphur, if it be allowed to cool in contact with iron it will give up a proportion of sulphur to the iron. Some iron allowed to cool under slag during a period of 120 hours had sulphur increased from 0.107 per cent to 0.153 per cent, an increase of 43 per cent. At the same time combined carbon had decreased from 0.508 to 0.020 per cent.

There is thus a temperature, which, for want of more precise data, we shall call the "red-molten" condition of iron, at which the slag has a lower combining power for sulphur than what iron has. And also, there is a temperature at which, though the slag has already combined with the sulphur, it will pass some of the sulphur into the iron if they be cooled in contact.

Melting hot is thus the means to adopt for best results, both in quality of iron produced and in fluidity by which the various castings may be run, each at its proper temper. If metal is produced of equal quality and fluidity each day, with a moderate expenditure of fuel, then you may conclude that intelligence and skill are directing the operations of the cupola. If, on the contrary, there is hot metal one day and dull metal the next, and this is almost always accompanied by an extravagant use of coke, you may conclude that there is some one about who does not know how to work the cupola.

DISCUSSION.

Thomas Hodgkiss: Will Mr. Buchanan please say what iron he used when he got 10.1 per cent of iron in the slag, and what iron when he got 1.9 per cent?

Robert Buchanan: We never melt the same iron two months together. The charges were as shown, viz., 6 cwts. of pig to 4 cwts. of scrap, and I cannot say exactly what brand of iron it was we were using when we got 1.9 per cent of iron in the slag. You will notice that the highest percentage of iron in the table is 10.10 per cent. I once read an article in an engineering paper in which it was stated that phosphorus could be reduced in the casting by filling the receiver of the cupola with wood, which I suppose would be changed into charcoal. I filled a similar receiver with clean hard wood and I got no phosphorus into the

slag, but a good deal of iron. I did not try that experiment again.

Walter Jones: For some time past I have been seeking information with regard to improvements in cupola practice. The more books I read on the subject the further I seemed to get from any definite result. One recommended a belt, another no belt. One suggests 4 tuyeres; others say 8, 16, or even 20; and one or two American articles recommended that the tuyeres should be put in different positions. Mr. Buchanan, on the other hand, tells us what to do with the plant, and gives his reasons for it. But there is one part as to which I should like some information. Some people say one ton of iron can be melted with 2 cwts. of coke, others say 2½ cwts., and others 3 cwts. In my experience I have found it has averaged from 3 to 5 cwts. The latter may be perhaps extremely high; but this again would partly depend on the number of hours the melt continued. On page 60 it is stated that for light castings 1 lb. of coke melts 7.87 lbs. of iron; and that for heavy castings 1 lb. of coke melts 10 lbs. of iron. I have heard it said repeatedly that this can be done; but I saw in an American paper some time ago that there is always less coke used in the office than there is in the cupola. I believe that is true, especially in regard to the people who sell cupolas. They forget the bed or they leave out some other important point.

W. W. Pagett: I believe it is the custom in America to have short melts. As a rule they will get through in two hours, whereas we in England go on for four or five hours. If we were to adopt their system, it would, in many of our foundries, involve very costly structural alterations. I think we err too much in restricting our cupola stagings. Rapid work means a great increase of ladles and of means for handling those ladles. Many of us do not possess the plant necessary to advantageously utilize the American system of rapid melting.

W. H. Richards: From what cupola does Mr. Buchanan get his results?

Robert Buchanan: From a modified form of the Stewart "Rapid." As I could not see why the gases should come into the receiver for the purpose of going up the pipe connecting the receiver and cupola, I altered the cupola a little. We always found the pipe filled with slag at the mouth, so we took the pipe away and made some other modifications. Taking it altogether it is a good cupola when it is in fair running order, but it is more troublesome than the ordinary cupola.

W. Kendrick: Is a belt an advantage over separate tuyeres, and a separate pipe to each tuyere from the main?

Robert Buchanan: I believe so; but I do not quite know. I like the belt. If there are a number of pipes coming out of a main in the ground they form obstructions round the cupola. The fewer pipes you have on the ground the better, so as to enable you to move freely about your cupola.

T. Chatwin: Yes, but you do not get the same blast pressure.

W. H. Richards: I find that separate pipes are better, and I think you get one-sixth more pressure with separate pipes than with a belt. Two mains can be run, one on each side of the cupola, with branches on. This will not be in the way of the cupola men. The distance from the tuyeres to the bottom of the charging door is given as fifteen feet; but my experience is altogether different from that. I think the cupola should be charged from ten to thirteen feet, instead of right up to the door. Now I agree that there is greater wear during the last part of the operation; but I do not think that is caused by the blast. It is caused by the fuel and the metal being removed, and then the lining falls in. I have noticed that scaffolding of the cupola is always followed by the falling in of the lining. If the cupola is charged up to the top, you cannot get a good biting blast, and that means slower melting. There is not a free outlet for the air, and the cupola gets damped, and this leads to the hanging of the charge over the tuyeres.

Robert Buchanan: I don't think there is anything in that. It is entirely a question of blast pressure and method of charging. If you are using small coke, and, possibly, small scrap, you can get your cupola very dense indeed, and that offers very great resistance to the passage of the blast through the cupola. What I say in the paper with regard to charging is true of the cupola I use, but I do not say it is true of every cupola. Every cupola must be put on its own merits. I have endeavored to avoid laying down one rule for all cupolas. There is a great deal we do not know about cupolas. In the past the foundry has not had the treatment it deserves, and has been considered beneath some people's notice. The longer I am at the business the less I agree with them. A little of the attention that has been given to other branches of engineering might well be diverted to the foundry, and endeavor made in quarters capable of teaching us all somethin-

so that foundry practice may be put on a higher plane than it has hitherto occupied.

W. H. Richards: I should like to know whether slightly sloping the tuyeres towards the center of the cupola, downwards towards the hearth, has been tried. Mr. Buchanan speaks of one of the modifications of the cupola being the height of them. What advantage would he claim from the height of them if he requires to get his charge down as gently as possible to the melting zone?

Robert Buchanan: As regards sloping the tuyeres downwards, I do not believe the air goes down. It may go down to the mouth of the tuyere, but it then at once begins to ascend. It has the coke in front and every gas in the cupola is ascending. If you want the air at the lowest point of the slope you might as well put the back of the tuyeres at that level. The sloping tuyere has the advantage that if the metal is rising and has got into the tuyere, if the man taps his furnace the tuyere will then empty itself into the cupola · but with the horizontal tuyeres the iron will run into the air belt. At the Carnegie works at Pittsburg there are cupolas 30 feet between the hearth and the charging door. The advantage of a high cupola is that the ascending gases are robbed of their heat by the descending charges of iron. It is desirable to take the heat from the gases. A month or two ago, to get an idea of the temperature of the gases which were passing the charging door, I put a rod of lead in with a pair of tongs. It took 1¼ minutes before it began to melt. Then I got a stick of solder, and that took ¾ minute before it showed signs of fusion. That showed the temperature of the escaping gases to be very low. It also showed that the heat in the ascending gases had been absorbed by the descending charges of iron.

T. Chatwin: Mr. Buchanan is quite right in saying that many makers do not reckon bed charges. I should like to know how it is that the coal used in kindling the cupola makes the first iron hard, while in America they use as much coal as coke. Then again, Mr. Buchanan recommends the use of scrap. But would that answer unless you waited until the pig-iron had melted?

Robert Buchanan: As to the coal used in kindling hardening the first iron, in America they use anthracite to melt with; but we don't kindle our cupolas with anthracite. I cannot absolutely prove that we get sulphur from the kindling coal, but the probability is that we do. In some coking coals there is as much as 1 per cent of sulphur. Even if it were only half of 1 per cent in the coal, it would get into the iron. We cannot compare our kindling coal with the anthracite used in America, for the sulphur in the latter is quite as low as the sulphur we have in our foundry cokes.

W. H. Richards: Reference has been made to a first charge being hard. That is because the bed is wet. There is always a lot of steam dormant until the blast is put on. Coal put into the tuyeres to clean them hardens the iron, but I don't know why.

Personal.

H. E. Hunter will have charge of the foundry at Spring City, Pa., lately put in operation by the Keystone Stove Works.

Chas. Aland, formerly superintendent of the New York Central Foundry, at Frankfort, N. Y., has accepted a similar position with Jas. B. Clow & Sons, New Comerstown, Ohio.

Daniel Reis has been appointed foreman of the Front Street plant of the Hoefinghoff & Laue Foundry Co., at Cincinnati, Ohio.

Thos. Markey, who for the past two years has been foreman of the Rockwood Manufacturing Co.'s foundry at Indianapolis, Ind., has been placed in charge of the Atlas Engine Co.'s foundry. The molding machine department of the latter company will be looked after by Frank Ellis.

William Davis has been appointed foreman of one of the shops of the Byram Foundry Co., at Indianapolis, Ind.

C. J. Faulhaber has accepted the position of foundry foreman with the Penn Radiator Co., of Corry, Pa.

L. C. Packham, formerly connected with the Michigan Malleable Iron Co., has been appointed manager of the Grand Rapids Malleable Co., of Grand Rapids, Mich. Mr. Packham succeeds I. Preston Rice, who recently resigned on account of ill health.

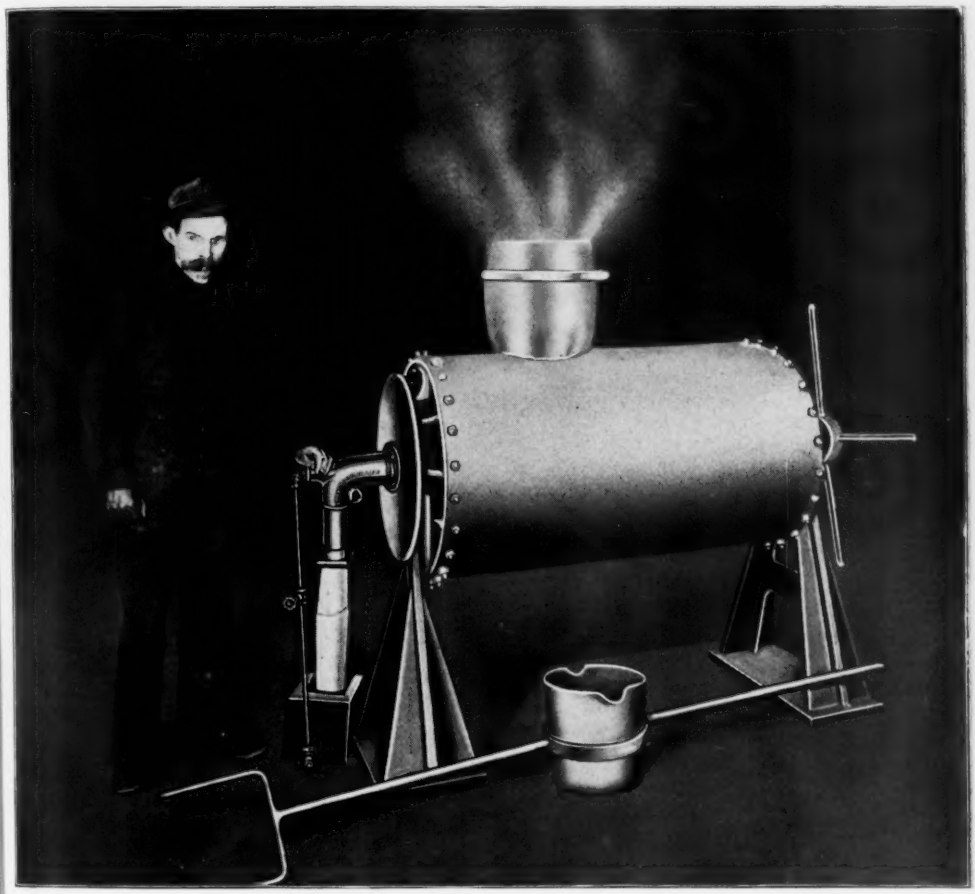
James Shennan succeeds William Hamilton as foreman of the Harlan & Hollingsworth Co.'s foundry, Wilmington, Delaware. Mr. Hamilton takes a similar position with the Newport News Shipbuilding & Dry Dock Co., Newport News, Va.

Paul R. Ramp, for several years manager of the C. B. & Q. foundry, at Aurora, Ill., has accepted a position as superintendent of foundry with the American Locomotive Co., Schenectady, N. Y.

W. S. McCrater has taken charge of the foundry operated by J. W. Penny & Sons Co., at Mechanics Falls, Me.

The Charlier Rolling Oil-Burning Furnace.

Various furnaces have been designed with the object of reducing the cost of melting such metals as are generally melted in crucibles. The expense attached to the use of the latter has offered a field for inventive genius, and on the continent of Europe, and in a few instances in this country, furnaces are in use which differ radically from the ordinary brass furnace.



THE CHARLIER FURNACE FOR CONTINUOUS MELTING.

Our illustration shows one of the latest furnaces of this class, designed by H. J. J. Charlier, formerly connected with M. M. Piat & Fils, of Paris, France, who are also builders of special melting furnaces, and later with the Ajax Metal Co., of Philadelphia. The Charlier furnace is now being manufactured and introduced to the trade by the J. W. Paxson Co., of Philadelphia. It consists of a casing, lined with fire brick, and provided with an opening at one end through which the fuel oil is sprayed into the furnace with the aid of a small fan blower, a supply of compressed air not being necessary, as is the case with some styles of oil-burning furnaces.

The oil may be pumped up by a hand pump, from a tank located below the floor level, preferably outside of the foundry, into a smaller tank placed at an elevation above the furnace. From this it is conducted to the burner by gravitation, and there met by a jet of air under a pressure of about five ounces. The supply of both oil and air can be regulated through suitable valves. A tank holding two or three barrels is large enough under ordinary circumstances and the insurance laws will permit of this being kept either inside or outside of the building, as long as it is kept underground.

After the furnace has been partially heated about half of the charge to be melted is thrown

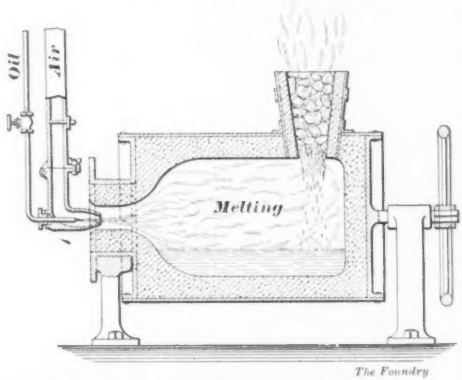
in and the balance fed through the hopper, for which it is customary to utilize a burnt out crucible having a six-inch hole in its bottom. The heat escaping from the furnace is utilized to melt the metal placed in the hopper from which it drops into the furnace and is there brought to greater fluidity. When the melting is completed the hopper is removed and the metal is poured through the aperture filled by the hopper.

SPECIAL PHOSPHORIZER FOR USE WITH CHARLIER FURNACE.

To put in a new lining the furnace is removed from the supports on which it is mounted and placed in an upright position, the bolts at one end are unfastened and the casing at that point taken off when the furnace may be lined as any ordinary cupola or brass furnace. It is calculated that a lining will last about four months, and that with the best of fire brick this will cost between $12 and $15. The shell of the furnace is 30 inches in diameter and 48 inches in length; when lined these dimensions are reduced to 16 by 37 inches.

Besides the economy resulting from the discarding of crucibles the makers claim additional advantages in having no fuel or ashes to handle and that no metal can be lost as in ordinary furnaces; consequently there is no need for machinery, usually employed to recover this, such as cinder mills and separators. No stack is required, nor any of the tools used in the handling of crucibles. The Charlier furnace in operation gives but little smoke or smell. The insurance laws allow fuel oil to be stored in tanks underground and pumped through pipes to the furnace. Fuel oil is of low test and will not flash like kerosene. The cost of keeping the furnace in operation is estimated at 20 cents per hour with fuel oil at 4 cents per gallon, and it is claimed that natural gas can be used to still better advantage.

The loss in melting through oxidation is said to be no greater than that which takes place when melting with crucibles. All kinds of metals may be melted in the Charlier furnace, the accompanying illustration being from a photograph taken when iron was being melted, after which a heat of brass was taken off, without permitting the furnace to cool down. Should slag be found in the furnace at the end of a heat it is simply turned over with the opening downward and the heat continued until this is all melted out, when any other metal may be charged without fear of contamination from injurious particles left over from previous melting. For melting ferro-manganese or ferro-silicon for use in steel casting, this furnace is claimed to be especially adapted. The metal may be kept in a fluid condition as long as desired, and should more be withdrawn than is needed for a mold the



SECTIONAL VIEW OF CHARLIER FURNACE.

balance may be returned to the furnace, where it is reheated in a very short time. Special advantage is claimed for this furnace in the melting of phosphor-bronze. The temperature in the furnace is entirely in control of the operator.

The melting capacity of the Charlier furnace under ordinary conditions is 600 pounds of brass per hour, nine heats having been procured in a day from one furnace. Five hundred pounds of iron have been melted in 2 hours and the same amount of steel scrap in 3 hours. Among other places these furnaces have been installed in the brass foundry department of the Wm. Cramp & Sons Ship & Engine Building Co., and the Hooks Smelting Co., both of Philadelphia. Furnaces will be built of a capacity up to 4,000 pounds and the J. W. Paxson Co. have an experimental plant in operation which is open for inspection and where the furnace may be seen at work.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and Using Cast Iron. Address all inquiries to W. J. KEEP, care of The Foundry.

DIRTY IRON.

A stove plate man writes as follows: "I am having trouble with my iron. The slag (or impurities) rises to the top of the ladle as the iron cools, and cannot be skimmed off, but is carried into the mold in pouring. Our mixture is South Pittsburg 30 per cent, No. 2. Warner 15 per cent, Etawah 15 per cent, No. 2 Hocking 5 per cent, scrap 35 per cent. The iron is soft, and with test bars 1 inch wide by 1-10 inch thick; the strength is 43 and 44 lbs. Any assistance you can give me will oblige."

Answer.—The chemists would say, you do not give the chemical composition of your pig iron, your scrap or your casting, so we have nothing to base an answer upon. They are correct. We must know the quantity of the influence exerted by the chemical elements, to be able to give an answer that will help the case.

The statement that the castings are soft shows that silicon is somewhere near what it should be, but what this writer might call soft might be considered hard by another founder.

The melted iron is not fluid enough. It can be made fluid in three ways, the most common of which is by increasing silicon. The use of No. 2 pig and one-third scrap would suggest that 10 per cent of silvery iron in place of that much No. 2 would increase fluidity. The irons mentioned are all below 1 per cent of phosphorus and I would use a silvery iron containing 1.50 per cent phosphorus to help increase fluidity. Then I would melt so as to make the iron very hot.

I would also add to each ton of iron about 20 lbs. of a very pure limestone to cause a very fluid slag to cover the melted iron in the cupola and to strain the iron as it melts. The scrap is no doubt dirty and rusty and the straining through the liquid slag will allow only clean iron to reach the bottom of the cupola. Iron should not be drawn off as fast as melted, though this is the usual practice in stove foundries. The bottom of the tuyeres should be about 12 inches above the sand bottom, and a slag hole should be about 8 inches above the sand bottom. The iron should be allowed to rise five or six inches, which would leave two or three inches of liquid slag to protect the surface of the melted iron. This is accomplished by making the tap hole so small that the iron will be held back in the cupola.

Now about the analysis. I do not see how a founder can make money without either chemical analysis or something that will accomplish the same thing.

As shrinkage varies inversely as silicon, a measure of the shrinkage each day is equivalent to a chemical analysis, so far as the practical effects are concerned. A test bar 1-2 inch square, or larger, will answer.

For stove castings the shrinkage of a 1-2 inch square test bar should be .130 inches per foot. If the shrinkage rises to .135, add a little more silvery iron; if it is less than .130, decrease the silvery iron.

Nothing can be gained by the use of a test bar 1-10 inch thick except to show the chilling quality of the iron. A test bar ¼ inch square or 1-10 inch thick will not give a shrinkage measure that varies with the silicon. And as a test of strength they are not reliable, as they bend too much before breaking. The remedy for foundry losses is a close daily measure of the influence of the elements in the iron. The name of an iron or the appearance of the fracture will not insure a given influence. It must be measured in some way.

CAN GRAY CAST IRON ABSORB CARBON WHILE BEING MELTED IN A CUPOLA?

Answer.—It cannot because the fact that it was gray before being melted shows that it was made in a hot furnace under conditions favorable to the absorption of carbon. The heat was greater than that of any cupola. At any temperature lower than that at which the

iron was made, if the iron is fluid, carbon leaves the metal. The carbon that colors the iron gray escaped after the iron became solid, but still was red hot.

The fact that melted steel (with no carbon) in contact with powdered coke or charcoal will absorb carbon has no bearing on the case, for under ordinary treatment it can hardly be made to absorb two per cent and when cold will not be gray because the iron can hold in chemical combination more than two per cent. and none will escape as the steel cools down. Iron will not make ordinary castings unless it contains more than two per cent of carbon, and it generally contains 3.50 per cent.

Silicon drives carbon out of iron, therefore any increase of silicon in melted iron that contains over three per cent of carbon causes some carbon to leave and as the iron cools it causes more to separate and color the iron gray.

Therefore, remelting iron, that contains carbon and silicon enough to make gray castings, cannot increase the carbon, but will always decrease it.

Melting Loss in Cupolas.—Foundry Costs.

Referring to this subject, Secretary R. Moldenke, of the American Foundrymen's Association, gives the following information relative to the loss in melting where burnt material is involved. In one instance a selection of burnt grate bars, in fair condition, was remelted. The charge of 2,000 pounds resulting in 1,875 pounds of good material. Melting loss, 6¼ per cent. The castings were entirely white; 0.4 per cent of ferro-manganese was added to a quantity of the melt, this, when set, was gray in fracture. Evidently the high silicon in the ferro-manganese did it. Another test with this treated material gave a depth of chill of 7-16 inch.

In the second case two thousand pounds of the worst burnt grate bars were melted, resulting in a melting loss of 8 per cent. The castings were again white, and this time the addition of 0.4 per cent of ferro-manganese had very little effect on the fracture. Similarly the chill obtained was ¾ inch.

It is very evident that the ferro-manganese, with its high silicon, expended itself in removing the oxidation effects, and could do little in promoting the formation of graphite.

Dr. Moldenke also gives the carefully compiled record of foundry costs in a certain shop, from which we reproduce the following averages, the foundry in question being engaged in general jobbing work, besides the manufacture of car wheels. The percentage of each class of castings made is not stated.

FOUNDRY COSTS.

Cost of Materials.	1901.	1900.	1899.	1898.
Metals	0.7694	0.8479	0.4942	0.4589
Melting	0.0436	0.0453	0.0380	0.0368
Molding	0.0080	0.0072	0.0063	0.0062
Cores	0.0161	0.0138	0.0123	0.0138
Salaries	0.4729	0.4550	0.4172	0.4346
Misc. expense	0.0583	0.0514	0.0417	0.0482
Cost per 100 lb. castings	1.3683	1.4206	1.0097	0.9985
Weight of good castings	17,802,844	21,965,408	23,562,841	20,117,909
Defective castings, per cent.	2.8	2.2	2.1	2.5

For a series of years the cost was as follows:

COST PER 100 POUNDS CASTINGS.

Yr.	Average.	Yr.	Average.	Yr.	Average.
1897	1.0866	1892	1.2892	1887	1.6906
1896	1.1469	1891	1.3457	1886	1.5600
1895	1.1332	1890	1.4611	1885	1.5900
1894	1.1442	1889	1.4842	1884	1.8200
1893	1.2687	1888	1.5320	1883	1.8700

Brass Mixtures.

A fairly cheap cock metal, one that will turn well and not leak at pressures up to 80 or 100 pounds consists of copper 35, zinc 7, lead 6, tin 2, selected scrap 50 per cent. The scrap should be of average machine quality, it must be carefully picked over and all traces of iron removed. A mixture for a similar purpose, consisting of all new metal, is copper 73, zinc 8, tin 7, lead 12.

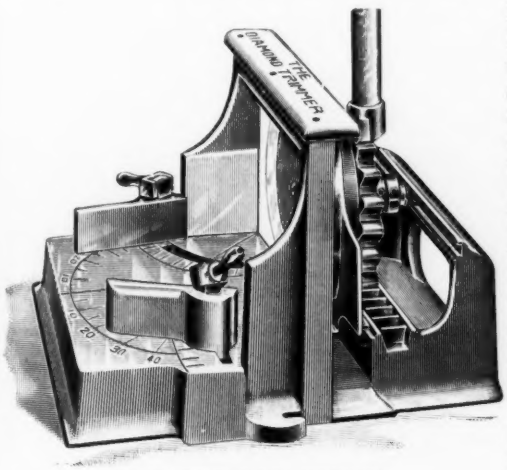
The best alloy for high steam pressures may be found in one of the three following compositions, that of number two yielding the best general results: (1). Copper 88, tin 10, zinc 2; (2) Copper 86, tin 10, zinc 4; (3) Copper 87, tin 8, zinc 5. Castings made from number two are specially suitable for steam pressures and this alloy is successfully used for high pressure valves and all classes of boiler mountings, etc. But for average practice these three alloys are too costly, in addition to the initial cost in the brass foundry, they are more expensive to machine and finish. Therefore, the two following mixtures are given for average steam valves and fittings: (1) Copper 80, zinc 10, tin 5, lead 5; (2) Copper 70, zinc 4, tin 4, lead 4, scrap 18. The latter one is fairly low in cost, as these alloys go, and if the scrap is carefully watched will produce good average quality valves and steam fittings. Gates and all home scrap should be kept in their own

particular quality and as such may be used as "mixed metal." The scrap referred to in the foregoing compositions is, of course, "foreign," that is, purchased from outside.

P. LONGMUIR.

The Diamond Wood Trimmer.

A new trimmer specially designed for use on the patternmaker's work bench has been designed by the Diamond Clamp & Flask Co. of Richmond, Ind. Advantages are claimed for the circular knife with which it is provided, giving it a shearing cut, without any tendency



THE DIAMOND WOOD TRIMMER.

to push the work away from the knife; the makers say this may be held on the table without using a stop. The Diamond Trimmer will take work 6 inches wide and 3 inches thick and cut this at any angle. An attachment goes with the machine for grinding the circular knife upon an ordinary grindstone, which allows sharpening to be done accurately and in a short time.

Among the Foundries.

The interests of the Thomas Mfg. Co. and the Little Rock Gin & Machine Co., Little Rock, Ark., have been consolidated under the name of the Thomas-Fordyce Mfg. Co. The new company have been incorporated with a capital stock of $250,000, and will operate both plants for the manufacture of cotton ginning machinery, engines, boilers, etc. The officers are A. D. Thomas, president; John H. Fordyce and R. W. Mattox, vice-presidents; O. H. Thomas, secretary, and Ben. D. Schaad, treasurer.

The Russel Wheel & Foundry Co., of Detroit, Mich., have increased their capital stock to $275,000.

The Hyde Park Foundry & Machine Co., Hyde Park, Pa., have increased their capital stock from $20,000 to $100,000, for the purpose of enlarging their plant and extending their business.

The John R. Morgan Engineering & Construction Co., of Columbus, O., recently incorporated, will build a thoroughly modern plant of large capacity, in which will be manufactured cranes, elevating and conveying machinery and ore hoisting and handling machinery. It is expected the plant will be in operation in from six to nine months. The machine shop will be 240x100 feet, the foundry 250x100 feet, and the structural and erecting shop 250x100 feet. All will be equipped with the latest tools, electrically driven, and the company expects to be in position to handle the largest contract work. The officers, several of whom have been connected with other engineering plants, are as follows: Edward Ackland, president; John R. Morgan, vice-president and general manager; Wm. G. Hildebran, assistant manager; Gilbert D. Preston, treasurer; Robert B. Bryson, secretary; Charles F. Neuwirth, engineer.

The Arcade Manufacturing Co., of Freeport, Ill., will add a brass foundry to its plant. J. M. Heck will have charge.

The Seestedt Bros. Manufacturing Co., of Romulus, Mich., will erect a foundry 60x80 feet for the manufacture of bath-tub castings and tank fittings. A brass foundry 30x60 feet is also included in the plans.

The plant of the Maywood Foundry & Machine Co., at Maywood, Ill., comprising a large foundry and machine shop, has been sold to the Featherstone Foundry & Machine Co., of Chicago. The managers of the Maywood Foundry & Machine Co. have decided to secure a plant in the city of Chicago, where they propose to continue the manufacture of Maywood molding machines and gas engines under the same name.

The Osborn Engineering Co., of Cleveland, have completed plans for the building and equipping of the extensive plant to be erected at Lima, Ohio, for the Lima Locomotive & Machine Works. They have also completed plans for shops to be located at Scottdale, Pa., for Kenney & Co.

The Sterling Foundry Co. has been incorporated at Cincinnati, Ohio, with a capital of $50,000.

The Ross-Meehan Foundry Co., of Chattanooga, Tenn., have added a department for the making of wagon skeins to their works.

The Rumsey Gas Engine Co., of Binghamton, N. Y., and the St. Johnsville Agricultural Works of St. Johnsville, N. Y., have consolidated and incorporated as the Rumsey-Williams Co., with a capital stock of $75,000. The new company will manufacture the Rumsey engines and Williams grain threshers at St. Johnsville.

The Lufkin Foundry & Machine Co., of Lufkin, Tex., has been incorporated with $30,000 capital. S. W. Henderson, J. H. Kurth, E. Wienes, F. Kavanaugh, Sr., and F. Kavanaugh, Jr., are the incorporators.

The Illinois Car & Equipment Co., Hegewisch, Ill., are building a malleable casting plant in which they will be able to meet the demand in their own works for malleables which is now the occasion of much delay directly attributable to slow deliveries. It will have a capacity of 20 tons a day. They are also increasing the capacity of the gray iron foundry. More important additions to the works are contemplated.

L. M. Rumsey and Geo. F. Speer have purchased the Fort Worth (Texas) Iron Works, and expect to improve and enlarge the plant.

The National Radiator Co., of Johnstown, Pa., succeeds to the business of the Fowler Radiator & Manufacturing Co., of the same place. There will be no change in management.

The St. Joseph Foundry Co., now being organized by T. C. Roberts, will erect a foundry and machine shop at St. Joseph, Mo. Mr. Roberts has for eight years conducted the Columbia foundry in the same city. He is also interested in a project to build a foundry at Kansas City.

The Pennsylvania Engineering Co., of New Castle, Pa., have increased their capital stock to $500,000.

The Sharon Brass Manufacturing Co. has taken over the plant of the Sharon Manufacturing Co., at Sharon, Pa., and will continue the manufacture of brass and bronze castings, plumbers' supplies, etc. The new concern is capitalized at $50,000, and the intentions are to considerably enlarge the present quarters.

The Columbia Foundry & Machine Co., of St. Joseph, Mo., has increased its capital stock to $12,000, and will install additional facilities to increase the capacity of its foundry.

The Fagan Iron Works, of Hoboken, N. J., will in a few weeks be removed to Jersey City, N. J., where a well equipped new foundry has been built, which will accommodate about forty molders. Architectural work will be made a specialty.

The Louis Lipp Co., of Cincinnati, Ohio, have nearly finished their new plant for the manufacture of bath-tubs and plumbers' supplies. Their old foundry will be operated by a new company, in which Fred Zellers, at present foreman of the Eureka foundry, will be interested. A general jobbing business will be carried on.

The Canada Switch & Spring Co., of Montreal, Canada, recently added a steel foundry to their plant, which is now in operation.

The Canadian Pacific Railway Co., in connection with their new shops at Hochelaga, Quebec, are putting up a malleable and gray iron foundry, which is to be furnished with all of the latest appliances and improved machinery.

W. H. Shenners, of Milwaukee, Wis., is forming a company, to be incorporated with a capital stock of $100,000, for the erection of a malleable casting plant at the new industrial town of West Allis, near Milwaukee, at which the great works of the Allis-Chalmers Co. are now being built. The manager of the new company is to be G. C. Russell, of Sioux City, Iowa. A tract of 6 acres has been secured.

The Pittsburg Malleable Iron Co., Pittsburg, Pa., is preparing plans for an additional 15-ton reverberatory furnace.

The Alabama Iron Works, Mobile, Ala., will expend about $12,000 in needed improvements.

The Best-Scott Foundry Co., of Warren, Pa., have put their new plant in operation.

The Sprague Foundry & Machine Co., of Council Bluffs, Ia., has been incorporated with $25,000 to conduct a machine shop and foundry. Robert M. Sprague and others, are the incorporators.

The Kutztown Foundry & Machine Co., Kutztown, Pa., expects to increase its capital stock from $50,000 to $100,000 to enlarge the plant.

The Hapgood Plow Co., Alton, Ill., is erecting a new foundry for making their own castings, of which they use from 4,000 to 5,000 tons yearly.

It is reported that the Normal Novelty Works, Normal, Ill., manufacturers of hardware specialties, will add a malleable foundry to their plant in the near future.

The Commonwealth Steel Co., 415 Locust street, St. Louis, Mo., have purchased 18 acres of land at East St. Louis, Ill., upon which they

will build a large steel casting plant which they expect to have in operation by October 1. The officers are: President, James Hopkins, vice-president Diamond Match Co.; first vice-president, Wm. F. Niedringhaus, of the National Enameling & Stamping Co.; second vice-president and manager of sales department, J. S. Andrews; general manager and secretary, O. S. Pulliam, formerly secretary of American Steel Foundry Co.; treasurer, L. J. Hayward, formerly treasurer of American Steel Foundry Co.; works manager, C. T. Westlake, formerly general superintendent American Steel Foundry Co.

The Canadian General Electric Co., of Toronto, Ont., has under construction the works of the Canada Foundry Co., which will be owned and operated by the former firm. In addition to furnishing the castings needed by the Canadian General Electric Co., the new plant will also handle architectural work, supplies for waterworks and railroads, as well as a general line of machine shop and foundry work.

The Geo. H. Smith Steel Casting Co., of Milwaukee, whose foundry was completely destroyed by fire on February 19, is taking immediate steps to rebuild. The company had recently completed an addition to its foundry, the entire plant covering a space of 300x150 feet. With the third 10-ton crane recently added and other new and up-to-date machinery the company had a well-equipped plant. As the boiler room and power plant were not totally destroyed, it will be possible for the plant to be again in operation within a few weeks.

The Snead-Van Alstine-Meldrum Co., Louisville, Ky., iron and steel structural work, and ornamental iron work, have been reorganized, with increased capital stock and facilities, as the Snead Architectural Iron Works. The officers of the new company are Bernard Seligman, president and general manager; J. A. Holmboe, vice-president and chief engineer; Bernard Bernheim, first vice-president, and Thomas S. Snead, secretary and treasurer.

S. K. Lovewell & Co., of Chelsea, Mass., will build a new foundry 50x80 feet.

The Iroquois Machine Co. has just been incorporated as a New York company, having been organized by Mr. W. W. Gibbs, who is also vice-president of the Kidder Press Co., of Dover, N. H., and a member of Gibbs-Brower Co., of New York City. The officers are Edwin A. Smith, president, Providence, R. I.; W. W. Gibbs, vice-president and general manager, New York; Henry C. Babcock, secretary and treasurer, Providence, R. I. Principal office, 150 Nassau street, New York. The company will manufacture new and improved wire-drawing machinery, which they claim will materially reduce the cost of producing wire. They will also manufacture a full line of automatic and plain drop hammers, swaging machines, rolling mills, roller bearings and grinding machines. Having ample capital, they have purchased the plant and business of the Universal Machine Co., located at Providence, and rented a large additional building adjacent to the same. The purchase of this running plant, and the addition named, will insure to their customers prompt filling of their orders. We understand they will erect a new plant during the coming summer, and that a foundry will be provided for at that time.

The G. L. Bollinger Co., contracting engineers, of Pittsburg, successors to the Liberty Construction Co., have bought a three-acre site at Verona, and will build a large manufacturing establishment. The present works, located at 2817 to 2823 Liberty avenue, Pittsburg, will be removed to the new location. Everything in the line of structural steel will be made. A foundry will be part of the plant.

The H. N. Strait Manufacturing Co., of Kansas City, Kan., are to add to their line the manufacture of Corliss engines, and for this purpose will build extensions to their machine shop and foundry, 100x210 feet each. Both buildings will be equipped throughout with new machinery, including electric traveling cranes of 20 tons capacity.

The recently incorporated Cherokee Foundry & Machine Co. are a reorganization of the King-Goodman Foundry & Machine Co., Cherokee, Kan., manufacturers of mining and smelting machinery, gas and gasoline engines, and general founders and machinists. The officers are W. C. Turkington, president; G. W. Pye, vice-president and treasurer; Geo. W. Stewart, secretary and general manager; J. N. Riley, superintendent of construction, and U. S. King, consulting engineer.

The American Hardware Co., of New Britain, Conn., with a capital stock of $5,000,000 will take over the works of P. & F. Corbin and the Russell & Erwin Manufacturing Co. The officers are: President, Philip Corbin; first vice-president, Charles M. Jarvis; second vice-president, George J. Laighton; treasurer, A. J. Sloper; assistant treasurer, Charles E. Wetmore; secretary, Theodore E. Smith.

The headquarters will continue to be in New Britain, where the policy will be determined. Both of the constituent com-

panies will maintain their identity as separate organizations, both in the manufacture and marketing of their goods, and will be managed by the directors of the combined corporation. While the details have not yet been completed, it is anticipated that the consolidation will be effected by May 1.

The Bradley Manufacturing Co., of Pittsburg, placed a contract with C. H. Bradley & Co., Jr., engineers, for the construction of three buildings in Allegheny to comprise their new engine building plant. The main building will be 380x35 feet, while a power plant and pattern shop will also be erected. The Bradley Manufacturing Co. was lately organized with a capital of $200,000, and will manufacture the Willans central valve engine. The president is D. J. Geary, Oil City; vice-president, C. H. Bradley, Jr., Pittsburg; secretary and treasurer, J. H. Bailey, Pittsburg.

The Keystone Bronze Co., 38th street and A. V. R. R., Pittsburg, will erect an addition to its foundry 50x120 feet in size.

The Chase Pump & Manufacturing Co., of Columbus, Ohio, will erect a new foundry.

The United Engineering & Foundry Co., of Pittsburg, are building an addition of 100 feet to the foundry of the Frank-Kneeland Works, in that city.

The Mechanics' Foundry & Machine Co., Fall River, Mass., have moved into their new foundry, recently built, which is 94x56 feet, of brick and modernly equipped. They have a capacity of ten tons a day of machine and general castings.

The Aetna Foundry & Machine Co., of Warren, Ohio, will increase the size of their plant in the near future. J. W. Russell is manager.

The Pittsburg & Lake Erie Railroad Co. will add a foundry to its shops at McKees' Rocks, Pa., for the casting of brake shoes.

One of the largest stove foundries in the country will be the new plant of the Pittsburg Stove & Range Co., at Beaver Falls, Pa., when this concern will concentrate its manufacturing operations. It is calculated that between 800 and 1,000 molders will be given employment.

The Fountain City Drill Co., LaCrosse, Wis., will build an addition to its foundry, 100x50 feet.

The Dimmick Pipe Co., Birmingham, Ala., is spending $25,000 in improving and enlarging its foundry.

The contract for the erection of the Cockfield-Getty foundry, Cedar Rapids, Ia., has been let. The main building will be 42x88 feet, one story, of brick. An addition 21x40 feet will accommodate the boiler and cupola rooms.

M. R. Zahniser, Washington, Pa., will erect a foundry. The main building will be 60x82 feet. Another building 25x32 feet will be for patterns, and a third, the furnace department, 20x60 feet. It will be completed by the middle of April.

Chas. Gilbert, formerly of Albany, Mo., is preparing to start a foundry at Pocahontas, Ark. It will be 30x80 feet.

Rhodes, Curry & Co., of Amherst, Nova Scotia, intend to erect a small malleable iron plant in order to more promptly supply themselves with castings of this material.

Albert S. Eberman has started a brass foundry at Jamestown, N. Y.

A. H. Springer, of Terre Haute, Ind., will erect a foundry in a new location where more room is available than in his present quarters.

The City Foundry Co., of Cleveland, Ohio, has increased its capital stock from $75,000 to $100,000.

The Battle Creek Foundry & Machine Co., of Battle Creek, Mich., recently organized, have consolidated with the Johnson Machine Works and will hereafter be known as the Johnson Foundry & Machine Co. Adolph Johnson will be manager of the new concern.

The Southern Foundry & Machine Co., of Knoxville, Tenn., has increased its capital stock from $10,000 to $75,000.

The International Steam Pump Co. is having plans prepared for new works at Harrison, N. J., where it has been decided to combine the Worthington shops, now located at Elizabethport, N. J., and Brooklyn, N. Y. As far as announced the plans provide that the numerous great buildings are to be so grouped that future extensions can be made without disturbing the general system of arrangement. The main buildings will be arranged along an L formation, so that the ends of each can be extended whenever necessary. There will be a main machine shop, 125 feet wide and 1,000 feet long, running from north to south. Running parallel with this structure and 150 feet in back of it there will be the erecting shop, 125 feet wide and 600 feet long. Both of these buildings will contain a gallery on each side of the center span. Between these buildings and connecting them is to be the high erecting shop, which will be about 120 feet high, 110 feet long and 150 feet wide. This building will be four galleries high. At the northern end of the intervening 150 feet between the machine and erecting shops there will be a bridge connecting them to a wash and locker house, 150 feet wide and 75 feet long.

Running from east to west at the south end of the machine and erecting shops the foundries and pattern shop will be located. The main foundry for heavy work will be 140 feet wide and 600 feet long. It will contain two cupolas. Parallel with it is to be the machine foundry, which is to be used for the lighter classes of work, including the bench molding and the molding machines. This building will be 60 feet wide and 600 feet long, and will contain one cupola. Only 400 feet in the center of the building will be used for this work, however, as 100 feet at each end will be reserved for a core shop and brass foundry, respectively. A platform the height of the cupola doors will be erected between the two foundry buildings. The pattern shop will be in back of this building, being 75x150 feet. In the rear of this will be the pattern storage warehouse. It will be 75x450 feet and will probably be six stories high. There will be another warehouse, 43x200 feet in back of this building. In the center space formed by the L arrangement of these buildings the testing department and shipping departments will be confined to a building 75x400 feet. The engine and pump house, 65x175 feet, and the boiler house, 50x175 feet, will also be located in this vicinity. The office and drafting room, 75x150 feet, will be at the extreme north end of the works.

The Whiting Foundry Equipment Co., of Harvey, Ill., have let the contract for an addition covering a space of 180x144 feet.

Chas. L. Nutter has purchased the foundry at East Bridgewater, Mass., owned by the Joshua Dean estate.

The R. G. Marcy Manufacturing Co., of Bluffton, Ind., are building an addition to their foundry 72x60 feet.

The Fleetwood Foundry & Machine Co. has been incorporated at Fleetwood, Pa., with a capital of $50,000 to manufacture agricultural implements and conduct a general foundry and repair business. The company is the successor of the well-known firm of Schaeffer, Merkel & Co. The present management contemplates making it one of the best and largest plants of its kind in East Pennsylvania. The following are among the incorporators: Adam W. Haag, H. F. L. L. Rummel, W. M. Zechman, E. R. Kemmerer and W. J. Fisher. Mr. Haag will be the superintendent of the plant, which it is expected will be in operation about April 1.

The Iowa Manufacturing Co., of Oskaloosa, Iowa, has begun the manufacture of soil pipe.

The Partridge & Alford Iron Works, of Los Angeles, Cal., has been incorporated with a capital of $30,000.

E. B. Marsh & Bros. Co., machinists, of Snydersville, Pa., have secured a location for their foundry in East Stroudsburg.

The firm of Werra & Willmann has been established at Manitowoc, Wis., to manufacture aluminum castings of all descriptions.

The new plant of the Buckeye Malleable Iron & Coupler Co., which is under erection in Columbus, O., is fast nearing completion. The main foundry building is 800x135 feet, while the auxiliary building is 500x100 feet. This plant will be devoted largely to the production of steel castings.

The recently organized Battle Creek Iron Works Co., Limited, Battle Creek, Mich., has purchased the plant and business of the Hastings Iron Works, manufacturers of house sinks, house registers, ventilators, stove-pipe registers, etc. The company will erect an up-to-date foundry and machine shop, and in addition to the specialty business they will do foundry and machine work in general. The officers are P. T. Colgrove, chairman; M. S. Curtis, treasurer; S. Greusel, secretary.

The Enterprise Foundry Co., Detroit, Mich., have increased their capital stock from $5,000 to $30,000.

Geo. Winterhalter & Son will start a foundry and machine shop at Sebewaing, Mich.

The Chas. G. Allen Co. has leased the foundry of L. S. Heald & Son, at Barre, Mass., and will operate this plant in addition to its own.

Contract for the erection of additional buildings to the steel foundry of the National Malleable Castings Co., at Sharon, Pa., has been awarded the American Bridge Co.

The Angels Iron Works, Angels' Camp, Cal., of which A. E. Perkins is manager, will erect a foundry and machine shop at Stockton, Cal., where the manufacture of mining machinery can be carried on with greater economy than in the present location.

W. M. Fanning is building an addition to his furnace works at Angola, Ind., part of which will be used as a foundry.

The Hofeller Brass Foundry Co. has been incorporated at Buffalo, N. Y., with $6,000 capital by Theodore Hofeller, Julius Hofeller and C. P. Moffett.

Allen Hackett has purchased the plant of the Island Machine Co., at Skowhegan, Me., which for some time past has been operated by a receiver.

The Chappell Furnace Co. is incorporated to do business at Morenci, Mich. Capital $15,000.

The M. B. Schenck Co., of Meriden, Conn., are preparing to start a foundry.

The American Brake Shoe & Foundry Co. have absorbed the Corning Iron Works and the Corning Brake Shoe Co., allied concerns, of Corning, N. Y.

W. H. Vye, proprietor of the St. Cloud Manufacturing Co., St. Cloud, Minn., has purchased the Stevenson foundry and will improve the same.

The Calorific Heater & Manufacturing Co., Allentown, Pa., has plans prepared for a new machine shop 50x140 feet; a foundry 40x100 feet, cleaning and testing building 30x40 feet.

John J. Marke has purchased a plant at Alexandria, Ind., which he will fit up as a foundry for the manufacture of oil and gas well drillers' supplies.

The Ohio Stove Co., of Portsmouth, Ohio, are building a 60x100 feet addition to their molding room.

William P. Skeen has purchased the plant of the Styers-Bowman Co., of Greensburg, Ind.

The Southern Car & Foundry Co. will add to its Anniston, Ala., plant a department for the manufacture of malleable castings.

The Winnebago Machine & Foundry Co., of Winnebago City, Minn., has filed articles of incorporation with a capital stock of $15,000.

The Le Baron Foundry Co., of Middleboro, Mass., has been incorporated with a capital of $30,000.

The Yale & Towne Manufacturing Co. are extending their brass foundry at Stamford, Conn., by an addition covering 75x40 feet.

The Simplex Railway Appliance Co., of Hammond, Ind., are having plans prepared for a number of improvements in which a foundry is included.

Earnshaw & Co., of Manila, P. I., have organized a company to operate a foundry and general machine works. C. A. Johnson, formerly with the Worthington Pump Works, will be superintendent of the plant.

C. P. Maxwell is contemplating the building of a foundry at Lisbon Falls, Me.

The Progress Furnace & Stove Co., of Springfield, O., who were recently burned out in the great East Shops fire, have under consideration the building of a new plant.

Wm Wright will build a foundry and machine shop at Waukegan, Ill.

The Deming Co., Salem, Ohio, are preparing to extend their foundry.

W. B. Wright has leased a plant at Youngstown, Ohio, which he will fit up as a foundry at an early day.

The Pomona Manufacturing Co. is organized at Pomona, Cal., to do a general foundry business.

Chas. W. Bradley, assistant foreman of the Pennsylvania Railroad foundry at Altoona, Pa. died Feb. 8, aged 62.

The Southern Foundry & Mach. Works, of Fredericksburg, Va., have been sold by Charles Tyler, of Baltimore, the owner, to John T. Dale, of Chicago, for $70,000. Mr. Dale will form a joint stock company and conduct the business on a very much larger scale than heretofore. The officers will be John T. Dale, president; Frank K. Tyler, assistant manager; L. Jeff Milbourne, secretary and treasurer. This foundry was established in 1847 and is one of the largest and best known in the South.

The Madison Avenue Foundry, of Cleveland, O., has been incorporated by Fred Metcalf, M. W. Peters, M. Merriman and others. The capital stock is $20,000. The plant of the East End Foundry Co. will be taken over.

The Heywood & Dobbins Iron Works Co. has been organized at Jennings, La. T. W. Adair is manager.

The Seabord Air Line will shortly enlarge its shop in Portsmouth, Va., by the erection of a foundry and the enlargement of its repairing facilities.

Sidney Denton, for many years foreman of Seaton's foundry, Atchison, Kans., has resigned and will go into business for himself at an early day.

Experience a Good Teacher.

The question often arises, What is the cause of a scabbed casting? The causes are numerous, and one, though rather infrequent, I know from sad experience. Some time ago I had a nozzle to mold, 18 inches diameter and 8 inches high, and was told to make a sure job of it, as boiler was ready to ship. This pattern was arranged with one flange loose, intended to be cast with the flanges horizontally, and leave its own centre core. Remembering the admonition I had received, I took great pains to produce a good casting. Everything worked smoothly until I came to draw pattern, when to my amazement I found that the inside of same was made with "back draught." After rapping, and driving in draw spikes, I proceeded to work pattern back and forth with a horizontal semi-circular movement, at the same time drawing upwards little by little. I

succeeded in getting pattern out in this manner without uprooting green-sand core, and when blacking the mold, I noticed that this part took on a very smooth finish, but thought little of it at the time, and felt satisfied that I had done a creditable job. No disturbance occurred when pouring, but next morning when casting was being cleaned, I was invited out to the chipping room to view my workmanship and found that the inside of the nozzle was one immense scab with not a smooth surface on it as large as a dollar. The only way I could account for this was, that in working the pattern in the manner described above, the pores of the sand became closed, having the same effect as when a mold is over-slicked. All molders know, or ought to, the result of an excessive application of the trowel on the face of a mold. It has a tendency to cause the particles of sand to disintegrate from the main body near the surface, and when pouring, this sand is washed off in patches, producing what is known as scabbing. H. W. BURY.

Deaths.

In the death of William H. Shick, of the Reading Stove Works, Orr, Painter & Co., Reading, Pa., which occurred on February 20, after an illness of several weeks, the Pennsylvania stove trade loses one of its oldest and most prominent representatives. Mr. Shick was born at St. Mary's, Chester county, Pa., on February 22, 1835, and at the age of 17 went to Milton, Pa., where he learned the stove molders' trade. He afterward moved to Philadelphia, and was employed in a number of stove works in that city until the outbreak of the Civil War, when he enlisted in the Seventy-second Pennsylvania Volunteers, and served for three years. At the battle of the Wilderness he was wounded and captured, spending some time in Libby Prison. After a captivity of several months he was exchanged and soon after honorably discharged from active service. At the close of the war Mr. Shick went to Reading and assisted in the organization of the Reading Stove Works, with which he was connected up to the time of his death. He was a member of the board of directors of the company from their organization.

Another veteran stove manufacturer passed away recently in the person of James S. Lithgow, president of the Lithgow Manufacturing Co., of Louisville, Ky., who died February 21, in his ninetieth year. He was born in Pittsburg November 29, 1812, and went to Louisville in 1833, where the firm of Wallace & Lithgow was organized in 1836, establishing one of the earliest stove foundries in the west. This was later succeeded by the Lithgow Manufacturing Co.

Pierpont E. Dutcher, president of the J. A. & P. E. Dutcher Co., steel founders, Milwaukee, Wis., died March 10, aged 47.

Robert Brayton, of L. Brayton & Co., River Point, R. I., was struck by a train and killed March 4.

Col. Wm. Stone, vice-president of the McLanahan-Stone Machine Co., Hollidaysburg, Pa., died February 16. He was born in Philadelphia July 21, 1819, and at an early age became an apprentice to the molders' trade at the shop of L. Morris & Co. In 1853 he became foreman of the Gaysport foundry of McLanahan & Jack, and served as such until 1856, in which year he became a partner of Mr. McLanahan, and their joint business interests have continued uninterruptedly until the present time.

Fires.

The foundry and pattern house of the Novelty Iron Works, Canton, Ohio, were destroyed by fire March 10. The loss is estimated at about $100,000, with $50,000 insurance. It is understood that the part of the plant destroyed will be rebuilt.

The Iola plant of the Pittsburg Foundry Co., at Iola, Kan., was destroyed by fire February 25. Loss about $7,500.

The Glauber Brass Manufacturing Co.'s plant, Cleveland, Ohio, was damaged by fire to the extent of $35,000 on March 2.

The Wayne Works, at Richmond, Ind., was destroyed by fire recently, entailing a loss of $50,000. It will be rebuilt at an early date.

The plant of the Lima Steel Casting Co., Lima, O., was destroyed by fire February 23. The loss is estimated at $50,000.

The foundry of the Gould Coupler Co., Depew, N. Y., was destroyed by fire February 18; loss $40,000. The plant will be rebuilt.

At Massillon, Ohio, February 18, the foundry of A. Heiman & Bro. was burned; loss $20,000. It was being operated by the Massillon Iron & Steel Co., who lost quite a number of patterns and flasks.

The Rock River Machine Co., Janesville, Wis., suffered the loss of their works on February 18. The main building was burned, containing the machine shop, foundry, blacksmith shop, store room and offices. The loss is nearly covered by insurance. The company are manufacturers of punches, shears and a

full line of hay tools. It is expected that the plant will be rebuilt as speedily as possible, as the company have a great deal of work on hand.

The W. D. Williams foundry and machine shop at Fredericksburg, Va., burned March 7, entailing a loss of $20,000.

Foundry Economy.*

BY RICHARD MOLDENKE.

The rapidity with which the buying of pig iron, on chemical specification, has spread among the foundries of this country, is perhaps the best evidence of the value of a rational method of procedure. Where at first the broker declined to sell iron under this arrangement, or exacted an extra 50 cents per ton, (one furnace even thinking a guaranteed analysis worth two dollars a ton above the market price), today the makers of foundry pig iron are almost altogether relieved from the annoying "Fracture Correspondence." That this revolution in practice has been no easy thing to accomplish, may readily be imagined, and even today the majority of founders feel a little shy of irons with the proper composition which do not show the accustomed fracture.

With the selling prices of castings finding lower levels at every period of depression, the founder naturally asks himself: "How will I keep my margin of profit unchanged? I have been as economical as possible in every way, and yet other founders, whose tonnage is no larger, are quoting lower figures and seem to be making money." The solution is not so simple, and will be found based on a good cost system in the office and scientific methods applied where needed in the shop. Just how the foundryman is to go about this work will form the substance of this paper.

Were it simply the question of employing an expert, the foundry doing a large business would soon be going in the right direction; but experts who have been through the changes of the last decade, and know what is wanted, are scarce. Technical graduates and others who can carry out the scientific manipulations required in a laboratory must be given a few years to acquire practical foundry experiences before they become valuable. The owner of a small foundry, therefore, finds it difficult to take advantage of those economies which great institutions have developed after years of pioneer work in their respective lines. The founder must do a little studying himself, of cause and effect in his foundry. He must so systematize his operations that should he not have a metallurgist on his staff, he need call in one only on occasion of troubles which require quick adjustment.

The most important consideration is naturally the daily product. This must be kept up to standard, and at the same time be as low in cost as possible. Here is where the cost accounts come in. One must know the cost per pound of the good castings sold for every department in the establishment. Thus if the cost of core-making runs say .25 cents per pound in one month, and it creeps up gradually to .35 cents in the course of the next three, it is time to see if the knife cannot be applied effectively, or failing this, to rearrange or place new machinery to get the work out to better advantage. On the whole it will pay to do the latter anyhow, for until the monthly figures are brought down to a point where there will be only a fluctuation of a few points, the department cannot be said to be in proper working order. Be it understood that this refers to a fairly uniform run of work. The principle involved, however, is a truly scientific one and should be applied in every manufacturing establishment.

The molding machine question will be found the most important one so far as the foundry pay-roll is concerned. A well-managed pattern shop and pattern storage system are also money savers. If the founder is personally systematic in his work, he will not tolerate slipshod habits in his employes; if he is not inclined that way, it were better for him to get an associate who is systematic. Then should come the establishment of systems of working marked by extreme simplicity and carried through with an iron hand, the head of the establishment setting the example.

The iron itself will naturally give the founder food for continuous thought, as it is a constantly changing factor. To effect the greatest saving in the cupola room, one must know what is there, what to buy, and how the material is handled. Take first the pig irons. They will either be piled up by car loads, or stacked together by brands and with grade numbers. Thus we will see a separate pile for Low Moor No. 2 soft, Sloss No. 2 plain, Isabella No. I X, Pioneer No. 4 and the Softeners.

Today the progressive foundry also has a number of piles. They are still separated by brands as formerly, this serving the purpose of locating any undesirable qualities shown by

*Paper read at a meeting of the New England Foundrymen's Association.

castings of an otherwise satisfactory composition. This statement requires further explanation. It is well known in the foundry trade that some irons are stronger than others, even where an analysis shows them to be of an identical chemical composition. This difference is most noticeable in irons of the lower silicon ranges, and in the case of charcoal and coke irons of the same cross-section. Among the charcoal irons we find that a cold blast metal is stronger than one made with warm blast, even if the former has more impurities. I have always contended that this lay in the manner of running the blast furnace, in so far as it affects the oxidiation of the resulting pig iron. A furnace which charges pure stock and runs normal should make strong iron. The forcing of the operation, however, coupled with the addition of quantities of mill cinder and salamanders of burnt iron which can have no chance for proper reduction before they are melted and in the bottom, can only yield an inferior product for remelting in the foundry, no matter how valuable it may be in the making of open hearth steel.

Since we are not yet able to trace the degree of oxidation of an an iron by chemical means with any certainty, it must be looked for in another way. The American Foundrymen's Association, which, through its active members has done so much to bring about the adoption of rational methods of buying and using foundry iron, will, it is hoped, in the near future develop the best methods of judging strong and weak pig irons of given compositions, so that the founder may prove to his own satisfaction whether he is getting the proper returns for his money.

As was stated above—by keeping the brands of iron distinct, inferior varieties are soon located by cutting out the suspected ones from the mixture, and noting results.

The piles are now arranged according to their silicon contents, due regard being paid to the other constituents as a matter of course. Thus, in the jobbing foundry, with sulphur and phosphorus normal in a given line of shipments, there would be one pile for 1.75 per cent silicon, one for 2.00 per cent, another for 2.25 per cent, and finally one for 2.50 per cent, or four piles. If there were three brands kept in stock in all the varieties, the number of piles would be twelve. If experience indicated poor results with the low silicon ranges of any particular iron, these would be omitted in making the next contract. For light work there would be extra piles for 2.75 per cent, 3.00 per cent, and even 3.25 per cent silicon, and special piles also for high phosphorus metals. Occasional bargains in high sulphur pig irons suitable for floor plates would also come in for this method of piling.

A letter of the alphabet painted conspicuously on each pile, and a stock book for continuous record will give the foundry superintendent the information wanted at a glance when making out his requisitions. This also conceals the identity of the iron so far as unauthorized persons are concerned, all the more so if the letters are changed about as the piles run out.

The ferro-silicons and silico-spiegels being only used in small quantities, and that only in emergencies, usually find a convenient resting place a little out of the way of the stock irons.

The scrap heap will form the next consideration. Two general classes must be reckoned with. That which we make and that which we buy or take in exchange for good castings. As will be shown later, it is necessary for the founder to know almost daily how his product is coming out, in order that he may keep his mixtures in proper shape. This information, consisting practically only of the silicon and occasionally the sulphur in the castings made, also answers for the domestic scrap. It is also possible to keep the low phosphorus scrap for low phosphorus mixtures.

With the bought, or as we call it, "foreign" scrap, things are a little different. As it is manifestly impossible to attempt a reliable sampling of this material in order to find out what it contains, we must do a little guessing on this point, and then use no more than the mixture can safely stand without upsetting our calculations. Fortunately certain lines of castings require irons of pretty generally understood composition. A piece of stove plate scrap, whether of recent date, or made 50 years ago, may be safely counted on as containing 2.75 per cent silicon, and 1.00 per cent phosphorus. Ordinary machinery scrap is never far from 2.00 per cent silicon, with phosphorus and sulphur normal. Heavy machinery may be classed as 1.75 per cent silicon, and if it should contain more, so much the better. Scrap rolls, plates, car wheels, malleable scrap; in fact, everything out of the ordinary line of foundry work should not be used in quantity unless an expert is at hand to see that it is properly cared for in the mixture.

The founder, then, who wishes to make up his mixture from day to day by more accurate methods than the cut and try, will first settle upon the proportion of pig iron and scrap the

necessities of the case compel him to use. He must take care of his own scrap in the first instance, and then look over the market prices of pig iron and scrap for the rest of his mixture; always remembering that the class of work he makes must not be injured by too great a cheapening of his melt. Cases may occur in which no foreign scrap is admissible at all, and your own, and a lot of steel in addition will only just let you out on the specifications. Unless you are running a sash weight factory 60 per cent of scrap, your own included, is about all you can safely stand. 25 to 40 per cent is a good average. It was my misfortune, through delays in shipment, to be left without any pig iron of the kinds I could use, in the yard for the period of four days, and 50 tons of castings had to be delivered daily under contract. A mixture consisting of 97 per cent scrap, most of it foreign, and 3 per cent silico-spiegel, containing 24 per cent manganese and 18 per cent silicon, answered all the requirements of the case, and nearly cleaned out the scrap pile. This is quoted not as an example to follow, but merely to show that a little science was a handy thing around the foundry just then.

For the purposes of the mixture calculation, suppose you prefer 70 per cent of pig iron, 15 per cent of your own scrap, and 15 per cent of foreign scrap. The size of the charge which experience has shown to be the most economical with your cupola is 5,000 lbs. You may use five charges one day and seven another. Of this 5,000 lbs. 3,500 will be pig iron, 750 lbs. your own scrap, and 750 lbs. foreign scrap. Experience has further taught you that the class of castings you make should average 2.10 per cent in silicon. This means 2.35 in the mixture, as about 0.25 per cent is burned out. Your scrap running 2.10 per cent silicon, and the foreign 2.00 per cent we have the following:

Domestic Scrap.
750 lbs. Silicon 2.10% gives total silicon 15.7 lbs.

Foreign Scrap.
750 lbs. Silicon 2.00% gives total silicon 15.0 lbs.

Or 30.7 lbs. of silicon of the 5,000 times 2.35 per cent, or 117.5 lbs. silicon wanted in the charge. This leaves 86.8 lbs. to be furnished by the 3,500 lbs. of the pig iron to be used. Now, in buying pig iron, it is always best to get the stock so proportioned that the greatest quantity on hand is that used to counterbalance the scrap put in. In the case under discussion, which is really that of the ordinary jobbing foundry, irons running 2.50 per cent in silicon are the ones required in greatest quantity, only smaller stocks of 2.00 per cent, 2.25 per cent, and 2.75 per cent being necessary. Let us therefore take 2,000 lbs. of say "Sloss" with 2.50 per cent silicon. This means 50 lbs. of the 86.8 accounted for. 1,500 lbs. must now furnish the remaining 36.8 lbs. silicon, or the iron would have to run 2.40 per cent silicon. As we do not have this in the yard, we can either reduce the Sloss a little and make up with iron running 2.75 per cent from the stock, or we may split up the remaining 1,500 lbs. into 1,000 lbs. at 2.75 per cent, and 500 lbs. at 2.25 per cent silicon from the yard. Doing the latter, as it gives us three brands of iron in the mixture instead of two, we have:

	Silicon.		Silicon.
Domestic Scrap.....	750 lbs. at	2.10% gives	15.7 lbs.
Foreign Scrap.....	750 " "	2.00% "	15.0 "
Sloss.....	2000 " "	2.50% "	50.0 "
Low Moor,.....	1000 " "	2.75% "	27.5 "
Mabel.....	500 " "	2.25% "	6.2 "
	5000 lbs.	with	114.4 lbs.

The mixture would therefore have 2.28 per cent, which is near enough to 2.35 per cent to pass. It is probably the simplest way to get it out. You can calculate it in your office in a few minutes, and be certain that the castings will come out right, if the mixture is properly handled and your materials are good.

Now, what is needed to make this work on mixture-making successful? Simply a knowledge of what is in your pig iron, and what is in your own scrap. Even this can be narrowed down to the silicon in both items for the daily run of work. I will go even further and say that two or three determinations of silicon a week, together with stocks of irons, well sampled and analysed as they are bought, and an occasional sulphur determination of your coke, is all that the jobbing or stove founder requires. I know cases where this work amounts to less than six dollars a week, or not even the wages of a laborer. I feel quite certain that many a young chemist would be glad to locate in a foundry centre if he can get that much from three or four foundries to begin with.

The above is naturally based upon the supposition that you, your sons, or your managers will do the thinking, the chemist only the manual work. Where you have enough thinking to do in this line to afford a good man in your works, get him, and your foundry foreman will thank you for relieving him from the responsibility and sleepless nights occasioned him by the changing of irons.

The application of rational methods in a foundry must be systematic to bring about the desired economy. It will not do to get an

analysis of a chip of iron, pay ten dollars for it, and expect that your mixture will cost you two-tenths of a cent per pound less laid on the charging platform. I read of a man recently who did this and then asked the foundry world at large what to do with his ten dollar analysis —his gold brick. If he quietly sits down and thinks over what has been outlined above, he will see the necessity for going at the problem slowly, carefully, and once the idea is absorbed, working it out systematically. He will then wonder at the extreme simplicity of science applied in everyday foundry practice.

Now comes an altogether different line of economy. How about your cupola house? Is your cupola tender really a man who will take pains with his work, or does he make a mystery of his job, keep the foreman at a distance, want only such and such irons, and go home when told to distribute his charges better? Have you still men with you who shovel in the material in a general mixture without separating into charges? I saw this done the other day and wondered what the castings would be like. Go among the molders a little and get their views on the iron tapped out and ten chances to one you will find the troubles coming from the charging platform. I had a cupola tender one day put on his coat and go home during a heat, and telling the men he would be sent for in the morning. I asked an intelligent laborer to jump in and better his prospects in life. My foreman and I stayed with him until he became proficient according to our standard of measurement. The result was better iron, no chances taken with the cupola and the charges, and the latter weighed correctly. Today that laborer is getting three dollars a day. The moral is: Go up and watch your men weigh out and charge, watch them daub cupola and ladles, make bottom, and see if things are done with precision and judgment. Here is a chance for foundry economy as shown by hot iron of uniform composition and gotten out in quick time.

I mentioned chemical specifications for pig iron several times. This is simple enough. We deal with silicon, sulphur, phosphorus, manganese and total carbon, important in the order named. The limits of these elements in foundry work are now generally known, and so we simply specify like this: For ordinary medium-weight machinery castings, silicon 2.50 per cent. This does not mean 2.00 per cent to 3.00 per cent, or even 2.25 per cent to 2.75 per cent, but nothing wider than 2.40 per cent to 2.60 per cent silicon. Make an agreement that everything between 2.25 per cent and 2.40 per cent takes the 2.25 per cent price, and you will have no difficulty in getting what you want.

To resume.—Manganese is specified to be not over 0.80 per cent, unless special reasons require an extension of this limit. Similarly phosphorus not over 0.80 per cent. Sulphur should not exceed 0.05 per cent, and if very soft castings are wanted total carbon may be required not under 3.75 per cent.

With the purchase of pig iron under chemical specifications, a good method of making mixtures which can be depended upon to produce the results desired, and the proper disposition of the charges in the cupola, the good that science can do the founder is accomplished in the main. There are of course many points which a well-managed laboratory can place on an economical footing, especially when we turn to furnace-irons, and special lines of castings. For the owner of a foundry which turns out say ten tons of castings every other day, it would, however, be unwise to establish this department as an adjunct to his works. He does better by sending his work out and learns all he can to apply the reports he gets properly.

Let is be understood that a good mixture mismanaged will give poor castings, but a poor one cannot under any circumstances turn out good work. The sole object of all this scientific manipulation is to start you off right, and then you must follow it up with due vigilance through every department of your work.

The Proposed Foundry Trade School.*

BY THOS. D. WEST, SHARPSVILLE, PA.

The drift of manufacture into specialties has brought employers to feel very keenly the want of skilled artisans, and is demonstrating the inability of workmen to comprehend and encourage real merit in the mechanic. These conditions are injurious in many ways to the advancement of labor, and to the welfare of the country; and there is urgent need of agencies that can assist in correcting these evil influences.

It is not that the manufacturer of specialties does not demand the best of a man as a true and skilled mechanic. Our specialty shops would be still better fitted to help sustain the supremacy of our country in everything pertaining to the betterment of mankind, by hav-

*Paper read before the Pittsburg Foundrymen's Association.

ing thoroughly trained mechanics, competent to skilfully adapt themselves to the various lines of any one calling, rather than being capable of performing only one line of work. The knowledge that they can do but one certain thing in any line of manufacture, discourages and kills the ambition of men, as well as a wholesome respect for their calling. Workmen of little or no ambition can never excel. This is a matter of every day observation. Our country is suffering keenly from this lack of ambition in its working classes. This is growing worse day by day and some steps should be taken to check its progress.

We now have two factors which make it difficult to secure young men who will make the sacrifice of working for small wages in order to learn a trade. One lies in specialty manufacturers not affording opportunities for making good skilled mechanics, or at least such that can feel that they are not tied to experience in one line of some specialty only. Present inducements are not sufficient to prevent the majority of poor boys accepting laboring work which generally gives them double what they can earn as apprentices. In fact, some men can often secure higher wages at common laboring than they can by following some branch of specialty manufacture which they have learned. When young men see this, it requires strong inducements to encourage them to faithfully serve out an apprenticeship. The second factor lies in the mechanical lines of work not receiving the social recognition they deserve, and hence many young men seek clerical occupations in order that they may have cleaner hands and clothes, although they may receive far less wages. Let conditions be created whereby young men may know that they can learn to be so highly skilled that they will be in demand at wages greatly in advance of what they can secure at common labor, or in clerical occupations, and a far greater number would be desirous of giving up their younger years to learn a trade than is now the case.

The art of founding is suffering keenly from the antipathy of boys to learning the trade, and the degeneration of skill due largely to the same forces that are effective in other callings. To assist in remedying these evils, a foundry trade school has been proposed. It is intended that this trade school shall accept, among others, boys having graduated from the public, grammar or high schools, who would bind themselves for three years and a half, as apprentices to learn the foundry trade in all its branches. This would embrace practice in green sand, dry sand, and loam moulding, and the management of cupolas. The sole aim of the school would be to teach students all of the art of founding that is possible in the limited time. To do this, students would be advanced step by step as fast as they mastered the work assigned them. The policy of keeping a student on one job, after he had learned to do it well, so as to make the most money out of his labor, as in general practice, would not be allowed, as such a policy would be detrimental to the aims and interests of the school. Such a trade school should make much better mechanics than is possible under present conditions, and even with the best opportunities in outside shops, would give our country better workmen in three and a half years than would a six to seven years' apprenticeship under present conditions.

In connection with the manual labor of learning the trade, it is intended that students shall devote three to four evenings a week to technical studies under competent teachers. These studies to be of direct use in the trade, and embracing mechanical drawing, chemical and physical metallurgy, business forms and practices. In addition to these studies, one evening a week would be devoted to lectures on the principles involved in the art of moulding, mixing and melting irons, also in studying the different ways in which common as well as intricate castings can be moulded. Illustrations of these would be taken from all sections of the country, so that when the apprentice graduated and commenced work elsewhere, he would find himself much more familiar with current practice in different parts of the country than apprentices are now in the best of shops. Such an apprenticeship with men of the right timber, would not only create most excellent mechanics, but could give our foundries a chance to secure a very high class of competent foremen, or managers.

The beneficial effects of this school in creating a higher class of mechanics would not only be that given to the young men coming from it, but its influence would set a pace for the general trade that could not be ignored, and hence, indirectly, aid shops at large in raising the standard of their mechanics and management. It is not so necessary that the school should be of great magnitude in order to benefit the country at large. The benefit inuring from the example it would set the trade, would be very helpful, and no matter how small the school began, much good would be done. In fact, such a school would necessarily

have to be small at the start, and its growth would depend upon the management and the public support it received. This, there is every reason to believe, would be of a very favorable character. Such a school could also take over the standardizing work of our Foundrymen's Association and operate for its section one of the stock laboratories, suggested in another article appearing in this issue, and be helpful in other ways to the general trade.

The above suggestions indicate what a trade school could do to give the country better mechanics and citizens, for any person placed in a position whereby he can command a good living, as a rule, makes a better citizen than the one who cannot do so. Having shown what a trade school could do, it is next in order to suggest a way for the creation and maintenance of such a school.

This trade school should be located in a prominent iron center where plenty of land is available, close to some large concern which requires enough castings to employ a dozen or more moulders, and as near a large city as practicable. Aside from making what local work the school might pick up, it should cater for a national trade in order to secure castings that would best illustrate the principles involved in the art of founding. The capital necessary should be raised by forming a non-assessable stock company so distributed that no individual should own a controlling interest. It would require from $75,000.00 to $100,000.00 to begin operations, a third of the money being held in reserve for working capital. The general foundry manager should have under him instructors of broad experience in moulding, etc., in the special branches to which they would be assigned. These instructors would have charge of the advancement of the students, taking the lead in the actual work, until they can be entrusted with it alone. The last six months of the apprenticeship might be utilized by the student in serving as instructor to new apprentices, thus giving him a review of past work and also affording some experience as a manager, it being the policy of the school to give instruction in this field also. The benefit of this alone in giving young men correct business ideas of management would be great, as, at the present day, there are no means for young men to obtain this training.

The wages paid to students should be those ruling current in general practice. If a student secures this in connection with the special advantages of the school, it would be all that should be expected by him. One of the requirements of this school would be to so bind students, if accepted after a trial, that they would forfeit a certain percentage of their wages, should they leave the school before the completion of their course. It is generally hardest to keep apprentices through the last year, as they then think themselves capable of earning more money elsewhere. To guard against this, it is necessary for wages to be small on the start and as large as may be feasible the last year. This, in connection with the continued advantages of learning more than elsewhere, and forfeiting back wages, should be sufficient to show students that it is greatly to their interest to faithfully serve their time.

The only drawback that can now be perceived to making a success of this school, lies in the probability of not obtaining enough students who could support themselves during the first year, as it can be readily seen that this school could not afford to pay students sufficient wages the first year to make themselves self-sustaining. This brings us to the critical point, and shows the great need of some liberal endowment, placed in the hands of trustees, to be wisely expended in helping to defray the living expenses of students during their first year, and also to pay for the technical instruction.

Any philanthropist who would donate sufficient money to do this, and thus help worthy students to get a start in life, would do a charitable work, and in such original lines as to command for him the unstinted praise by all those interested in the uplifting of mankind. Some might think that such a school should be able to do all this without endowment. This school would have to go into the open market and compete for its work with other concerns, and with the disadvantages of having to pay big wages to obtain competent instructors in the foundry departments, and the loss of time necessary to educate students so that they could do work profitably, it could not be expected that anything very extra in the way of dividends could be secured to stockholders. Nevertheless, the institution should pay sufficiently well to induce individuals to risk something as stockholders in helping to start and maintain such an institution, in consideration of the good it can do the trade and country at large. The donations and stock subscriptions are two distinct propositions. The former makes possible the elevation of poor boys, who must otherwise go through life, barely able to support themselves, to say nothing of being of any benefit to their fellowmen; while the latter is a risk in business enterprise.

The necessity for a foundry trade school was discussed at the convention of the American Foundrymen's Association, at Buffalo, last June. The idea was thought so feasible, and the object such a worthy one, that a committee was appointed to proceed with the matter and make a report of progress at the next convention, which will convene in Boston, June 17-19, 1902. The committee consists of Mr. Thos. D. West, chairman, Sharpsville, Pa.; Mr. E. H. Putnam, Moline, Ill.; and Dr. Richard Moldenke, New York. This committee will be glad to learn of those who think favorably of assisting in financing the project, especially any broadly experienced molders who could take stock and assist as instructors as well as of philanthropists who would take pleasure in tendering a donation to the endowment. As there are but a few months before the first progress report will be made, the committee hopes that sufficient interest will be manifested to cause the coming convention to tender its hearty support to the commendable cause presented here for serious consideration.

Perpetual Motion.

With wireless telegraphy invented, the question arises what will come next? It is on the end of everybody's tongue, Perpetual Motion. But till then let us look around and see what is nearest to perpetual motion in our own line of business, and we find that it is "that incessant howl for better molders."

I never heard or read about an owner of an iron foundry who died of worrying over how the life of his molder might be lengthened. None of those who have come under my notice have made any special effort to keep the dirt scraped off the windows of the shops so that a molder's eyes would not bulge out of their sockets whenever he tried to look into some obscure and intricate corner of his mold, where he has a suspicion there is enough sand located to spoil the casting. What? Ask for a lamp? Why, the foreman would say: Don't you see the sun shining?

Then there are a number of shops who might, with profit to themselves, have a few of the cracks of the building stuffed up in the winter time. If the draft was only steady from these cracks the boss could lay the blower aside for the winter at least, as all he would have to do would be to connect the tuyeres, when it would only take one-half the time to melt the iron, besides there would not be any waste of power. The only reason why this system is not used is that the wind is liable to change and the tuyeres would then have to be shifted too often.

Just catch a boss reading an advertisement like this: It is only the first cost of the machine; with it one man can do the work of two. Instantly he counts up how many machines he can use, telegraphs his order to the machine builder, and then he sits down and begins to think about laying one-half of his men off.

How different a view could be painted if the boss read an advertisement like this: It is only the first cost of installing a heating plant in your foundry. It will make your foundry twice as comfortable as it is. He will give a soft chuckle and say: If that fellow wants to be a philanthropist why don't he go into the undertaking business and give away free coffins; nobody would laugh at him and think he was foolish.

Then again, there are people in the trade who are not satisfied with that "howl" for better molders, so they have started to "howl" for better apprentices. I see my friend, P. R. Ramp, has started the ball rolling in this direction in the March issue of THE FOUNDRY. What he says pertaining to apprentices is very nice on paper, of course, so was the Hartsfeld furnace as long as it stayed on paper.

If a molder knew all a boss expected him to know for two or three dollars a day his brains would be so big that he would have to use a washtub instead of his head to hold them. There would not have to be any trade journal, as an all-around molder would know it all. The general supposition that a molder can work better when he is filled with booze than he can when he is sober, is wrong, but it applies to a few cases where the molder only knows how to work wrong, and when he gets full he does not know whether he is making the casting right or wrong, and luck generally favors him and the casting comes out right. Thus he thinks that the more he drinks the better molder he is, but if this were the case every foundry would have a brewery attached to it, and they never would get bad castings.

W. E. T.

A Greenhorn's First Impression of a Foundry.

It was a very green youngster that applied for a job of cleaning castings at the foundry. He was not very large and did not look very rugged, and if he had not been persistent, and help scarce, his chances of getting work would not have been bright, says W. Osborne in the *American Manufacturer*. He was taken on, after hanging around for several days, and

tried to make up in energy for what he lacked in strength.

Born in the country, away from any fair sized village, even, and fresh from school, everything appeared wonderful to him.

On casting days, which came twice a week at first, and when a little extra help was needed, he was called into the foundry to give such help as he was able.

At such times his mind was filled with awe and bewilderment. Awe to see iron, his comparison for extreme hardness and strength, being carried about and poured into holes in boxes full of sand. Bewilderment to fathom the means by which the many varied forms he was laboriously trying to free from sand and ragged edges, were produced.

Among the things that bothered him were the names used.

Why was a wooden box without any bottom to it called a flask, which was a bottle in his mind?

Why did this man call one a grate bar flask today and that one call it a heater flask tomorrow?

How nice and cool it was in there when the men had nothing to do but just fill those boxes with sand and pound it in with the end of a club, or, if their arms were tired, get up and step around on it, while they rested them. Then what fun it was to draw those pieces out of the sand and sit down and smooth it all up nice.

He was not so far removed from babyhood but that the sight brought up recollections of happy hours spent with brother, sister or neighbor, patiently doing the same thing, using hands, feet, or sticks as patterns, and being well pleased to be allowed to do it without reward.

Here, it seems, they were paid; well paid; much better paid than he was, and having lots of fun besides. He was content to spend his spare time at noon trying his hand on a spare pile of sand and seeing if he could get all the wrinkles in the sand that the cogs left there.

The name they called these men was mystifying—molders. He knew what mold was; had often seen it on the top of crocks, and sometimes on bread and other things, but could not see any connection between it and these men.

No private ever felt more awe for his commanding officer than this lad, when first called in to carry iron, did for the molder at the back end of the ladle.

The state of mind produced by the varied, voluminous, and energetic profanity hurled at him by Harry (the fair-haired, and cross-eyed, who could look toward both sides of the shop at once, shake his head in all directions, make more noise, use more words, swear harder and convey less information by it all than any man in the state), is still connected in a measure with foundries and foundry work. If he should today have a molder ask a laborer to do anything in a polite way, or thank him after it was done, it would produce a distincet impression as something new and strange.

Then the best molders used to come out and look over the castings as he was cleaning them, and tell how they got a run-out, but managed to save it; how that was poured too hard, but would do; how the helpers were so slow getting to the mold that the iron nearly froze; how that was a shade short, but was in a hurry and would pass. How Jim, the foreman, was getting too fresh, and if he didn't take a tumble and call his mouth off a little they would throw up their jobs and just stand around and see the foundry go to the dogs. There were some ordinary fellows in the foundry who never seemed to be able to make those varied castings, and who seemed to respect Jim, the foreman. "They are suckers, you know."

At such times the lad used to seriously think of going and hunting the "Old Man" up and giving him a little friendly advice to the end that he might be able to keep these fine molders, and perhaps he even ought to know what a poor kind fellow Jim was as a boss.

You see the "Old Man" used to come around and chat with him once in a while, and so he had the interest of the firm at heart.

He can still recall his feelings when in casting things would get dark, and the room seem to swim unsteadily, and he would crawl to the door for a breath of air.

Little drops of iron running down his back or into his shoes were hard to bear, and the awful cracks that seemed to come from under his feet startled him, but that ladle must be held still and steady, or an awful fate was waiting for him; but to help him was the idea that some day he might be on the other end and know how to control all these mysteries.

When his reverence for the molder was at its height, another actor appeared on the scene; this was a tall young man with a peculiar white look to his face that the dirt, which seemed in some way different from the dirt on the molders' faces, only seemed to make more noticeable.

He called for Jim, the foreman, and when that worthy appeared, began to berate him in very vigorous style. Jim evidently felt bad, and seemed to want some help as the visitors to the casting pile were called forward, and Jim's share was mild to what they received.

The boy stood a silent and trembling spectator, expecting to see the violent young man perish in his youth, or see the finest molders in the country leave the shop and have it go to destruction.

To his surprise they seemed cowed and humble, while coming out of the torrent of sound could be heard such expressions as, "Must have chopped it out with an axe"; "Ought to be working on the railroad section"; "A blind man could do better"; "Better get a hod," etc.

After this young man had exhausted himself and withdrawn, the boy learned that he was the boss machinist; that the machinists' business was chiefly to stand around taking it easy, while the machines did all the work, and that he spent most of his leisure in trying to find things to kick about to the molder about his castings.

This led to an investigation, and finally ended in the boy hunting an opening to join the ranks of this highly superior class who were a step beyond the molder in ease.

By some fatal oversight of the owners of foundries those extra good molders have never been put in charge of a foundry; indeed, there seems to be a conspiracy to keep them down.

They patiently travel from foundry to foundry, only working a short time in each, that all may have the benefit of their wisdom.

In spite of all their efforts (and they labor incessantly on the streets corners, in bar rooms, and any other place where they are able to find a good man wanting the benefit of ripe experience), no such casting can now be made as they used to make, and when they are dead the art of molding will sink to a very low plane, indeed.

If you doubt this ask the first one you meet; you will know him by his breath.

Notes from Various Sources.

The J. W. Paxson Co., of Philadelphia, has opened a branch in Baltimore, Md. W. Scott Thomas will have charge of same with offices at 1102 Union Trust building.

The S. Obermayer Co. has engaged W. W. Root, formerly representing the Big Four at Kansas City, as traffic manager. He will in the future look after the entire railroad business of the factories of the company, which are located at Cincinnati, Chicago and Larimer, Pa. He will have his headquarters at Cincinnati.

The Diven-Deved Foundry Co., for conducting an iron foundry business, has been incorporated at Baltimore, Md., by Geo. L. Deved, James Bartol, Charles B. Kranz, John W. Diven and Thomas M. Diven. The capital stock is $50,000.

The Spuck Iron & Foundry Co., of St. Louis, Mo., has become incorporated with a capital of $75,000.

Wilson & Du Bois, the latter formerly connected with the Cornell Iron Works, of New York City, have established a plant for the manufacture of Anti-Friction Metal, at 549 West 25th street, New York. They will make a specialty of the "Thistle" brand of white metal.

The Sargent Co., of Chicago, whose plant at Chicago Heights, Ill., was recently taken over by the American Brake Shoe & Foundry Co., will continue its present corporate existence with the open-hearth steel plant at Fifty-ninth and Wallace streets, the capacity of which will be doubled.

Robert Williams, of Houghton, Mich., for several years connected with the Hodge Iron Co., of that place, is interested in a company which is being formed to establish a new foundry at that point.

Some of the nicest literature issued by foundries is found in the advertising matter put out by the Cincinnati Bell Foundry Co., of Cincinnati, Ohio, makers of the Blymyer Bells. It is so much out of the ordinary that it is well worth patterning after.

The Mahoning Foundry & Machine Co., of Youngstown, Ohio, will build a $10,000 foundry and machine shop.

The Handbury Heater Co., of Peoria, Ill., has been incorporated with a capital of $25,000, by J. D. Handbury, G. T. Handbury, E. H. Couch and W. F. Heyle. In addition to heating appliances gray iron castings will also be made.

Chas. T. Boynton has been admitted to partnership in the firm of Pickands, Brown & Co., Chicago.

The Philadelphia Pneumatic Tool Co. has appointed Messrs. Berger, Carter & Co., No. 330 Market street, San Francisco, Cal., their representatives on the Pacific coast.